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REPORTS

OF THE

COMMISSIONERS OF THE UNITED STATES

TO THE

INTERNATIONAL EXHIBITION

HELD AT

VIENNA, 1873.

PUBLISHED UNDER DIRECTION OF THE SECRETARY OF STATE
BY AUTHORITY OF CONGRESS.

EDITED BY

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VOLUME I.

INTRODUCTION; EXECUTIVE COMMISSION; AGRICULTURE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1876.

AN ACT to authorize the President of the United States to appoint one or more commissioners to represent the Government of the United States at the international exposition of agriculture, industry, and fine arts, to be held at Vienna in eighteen hundred and seventy-three.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States be, and he hereby is, authorized, by and with the advice and consent of the Senate, to appoint one or more agents to represent the Government of the United States at the international exposition of agriculture, industry, and fine arts, to be held at Vienna in eighteen hundred and seventy-three: *Provided*, That such appointments shall not impose on this Government any liability for the expense which they may occasion.

Approved, June 10, 1872.

JOINT RESOLUTION to enable the people of the United States to participate in the advantages of the international exposition to be held at Vienna in eighteen hundred and seventy-three.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to enable the people of the United States to participate in the advantages of the international exhibition of the products of agriculture, manufactures, and the fine arts, to be held at Vienna in the year eighteen hundred and seventy-three, there be, and hereby is, appropriated, out of any money in the Treasury not otherwise appropriated, the sum of two hundred thousand dollars, or so much thereof as may be necessary for the purpose herein specified, which sum shall be expended under the direction of the Secretary of State: *Provided*, That the President be authorized to appoint a number of practical artisans, not exceeding eight, and of scientific men not exceeding seven, who shall attend said exhibition and report their doings and observations to him, and whose actual and reasonable expenses, not to exceed one thousand dollars each, shall be paid from such fund; and that the President be further authorized to appoint a number of honorary commissioners, not to exceed one hundred, who shall receive no pay for their expenses or otherwise: *And provided further*, That no person so appointed shall be interested, directly or indirectly, in any article exhibited for competition: *And provided*, That not more than fifty thousand dollars shall be expended for salaries and expenses of all persons receiving appointments to places authorized in this resolution, and not more than five thousand dollars shall be paid for salary and expenses to any one person.

SEC. 2. That the governors of the several States be, and are hereby, requested to invite the patriotic people of their respective States to assist in the proper representation of the handiwork of our artisans, and the prolific sources of material wealth with which our land is blessed; and to take such further measures as may be necessary to diffuse a knowledge of the proposed exhibition, and to secure to their respective States the advantages which it promises.

SEC. 3. That it shall be the duty of the Secretary of State to transmit to Congress a detailed statement of the expenditures which may have been incurred under the provisions of this resolution.

Approved, February 14, 1873.

DEPARTMENT OF STATE,
Washington, March, 1876.

The purpose of the Austro-Hungarian government to open an international exhibition at Vienna in the year 1873 was first officially communicated to the Government of the United States in a note addressed to the Secretary of State on the 29th of June, 1870, by Baron Lederer, then envoy extraordinary and minister plenipotentiary from Austro-Hungary at this capital, who requested that the fact might be brought to the attention of the proper authorities of the United States, and that they might be requested to contribute to the success of the enterprise.

Upon the 12th of July, 1870, a communication was addressed by the Secretary of State to the Committee on Foreign Affairs of the House, and to the Committee on Foreign Relations of the Senate, looking to a submission of the subject for the consideration of Congress.

Upon the 22d of September, 1871, a further note was addressed by Baron Lederer to the Secretary of State, stating that preparations for the proposed exhibition had been begun, and that the imperial and royal government, attaching much importance to the co-operation of the United States in the exhibition, had authorized him to invite the Government of the United States to take part therein. Copies of the notes of Baron Lederer and of the replies of the Secretary of State were transmitted to the chairman of the Committee on Foreign Affairs on the 7th of December, 1871.

By an act of Congress passed in the month of June, 1872, the President was authorized, by and with the consent of the Senate, to appoint one or more agents to represent the Government of the United States at the proposed exhibition, and a commissioner was accordingly appointed for the purpose mentioned in the act, and subsequently other agents were commissioned to assist him in his duties. In the month of February, 1873, Congress passed a joint resolution making an appropriation to enable the people of the United States to participate in the advantages of the international exhibition to be held at Vienna, and authorizing the President to appoint a number of practical artisans, not exceeding eight, and of scientific men, not exceeding seven, who should attend the exhibition and report their doings and observations to him, and provision was also made for the appointment of a number of honorary commissioners.

Pursuant to this resolution, commissioners were appointed of the three classes therein specified, who proceeded to Vienna, and from certain of whom reports have been received upon various subjects connected with the exhibition.

The reports are now published in accordance with a joint resolution of Congress passed in the month of June, 1874, providing for the printing of these reports of the commissioners, under the direction of the Secretary of State.

The work of editing the reports has been assigned to Prof. R. H. Thurston, late United States Scientific Commissioner to the Vienna Exhibition, and connected with the Stevens Institute of Technology at Hoboken, N. J. They are preceded by an introduction, prepared by the Editor, containing information respecting the organization and management of the Vienna Exhibition, and the part taken therein by the United States. It is believed that the reports as presented by the Editor, with the introduction prepared by him, will be found useful and valuable.

HAMILTON FISH.

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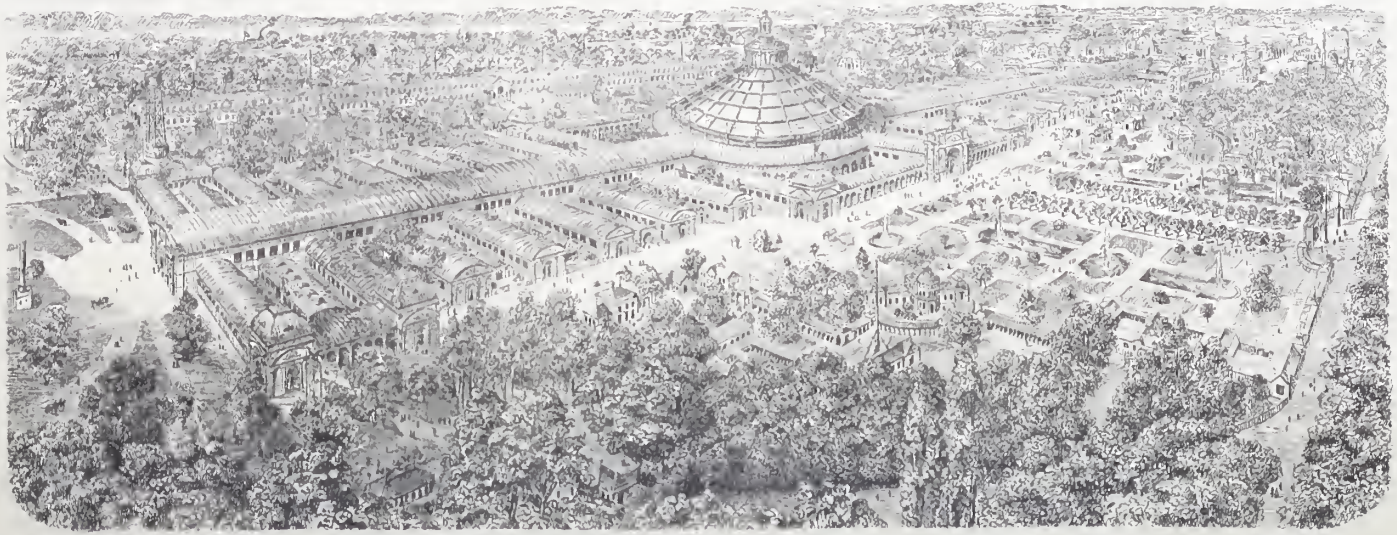

Birds-Eye View of the Industry Palace and Machinery Hall
with Annexes and Pavilions.

AN INTRODUCTION TO THE REPORTS

OF THE

COMMISSIONERS OF THE UNITED STATES

TO THE

VIENNA INTERNATIONAL EXHIBITION, 1873.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1876.

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THE INTERNATIONAL EXHIBITION AT VIENNA, 1873;

ITS

ANTECEDENTS AND INCEPTION,

ORGANIZATION, ADMINISTRATION, AND RESULTS.

COINS, WEIGHTS, AND MEASURES.

The constants used for reducing different measures and values in the following pages are given below. All prices are given as far as possible in the money of the world.

VALUES.

£1 = $4.8665.
1*s* = $0.24.
1*d* = $0.02.
1 franc = $0.19417.
1 sou = $0.01.
1 florin = $0.473.
1 kreutzer = $0.0079.
$1 United States currency = $0.8925 gold.

MEASURES.

1 linear meter = 3.2808693 linear feet.
1 square meter = 10.7641 square feet.
1 cubic meter = 263.1 United States gallons.
1 force de cheval = 0.9863 horse-power.

All values and quantities are reduced to United States standards, all money being given according to the average rates of gold exchange.

PREFACE.

In the preparation of an introduction to the reports of the United States commissioners to the International Exhibition at Vienna, 1873, the Editor has considered it proper to confine himself closely to such facts as are of essential importance as indicating the inception, progress, and results of that great enterprise, and the following account is therefore a mere historical outline.

The reports of the Chief Commissioner and of the members of the Scientific, Honorary, and Artisan Commissions of the United States embody all that is required to make the reader thoroughly acquainted with the extent, character and importance of the exhibition. While some departments have not been reported upon, and others have had the attention of two or three reporters, and while, therefore, the mass of knowledge embodied in these reports is somewhat unsymmetrical, it is fortunately the fact that the most important classes have been usually carefully studied and well reported. The gentlemen to whom the task of reporting was intrusted have placed before the public in these reports an immense amount of information which is of great interest and which will probably prove of very great value to the nation.

It has been thought advisable to supplement the reports of the official representatives of the United States by abstracts of the official reports of other nations where the latter have been found to contain criticisms of the exhibits of the United States section.

Such criticisms, made as they are by the ablest men of Europe, are extremely valuable as indicating not only the judgment of acknowledged experts in their several branches, but as exhibiting the real standing of our manufacturers and producers with the people of Europe, and as enabling our countrymen to see themselves as others see them.

While reading these criticisms, however, it should not be forgotten that the writers usually studied the exhibits which they criticise from a very different stand-point from that occupied by the reader. Living under influences radically different from those surrounding a citizen of the United States, trained in habits of thought almost equally different, accustomed to methods which are strange to an American, and controlled by a conservatism such as is unknown on this side the Atlantic, it is to be expected that there should sometimes exist decided differences between their views and those held by our own people.

Yet it will be seen that custom has not, on the whole, impeded a fair examination, and unfavorable prejudice has not interfered with the expression of an honest opinion. It would seem, in fact, that there exists in Europe a somewhat powerful prejudice in favor of whatever comes from the United States. In manufactures, more especially, and in the details of mechanism, the American is evidently looked upon as a leader; and meager as was the display made at Vienna, in the eyes of our own people, it has sufficed to corroborate the opinion previously entertained by Europeans, that the United States market for machinery, and some other manufactured products, is very likely soon to become greatly extended among the countries of the eastern hemisphere.

These abstracts of foreign reports will also be found of essential value as complementing those of our own commissioners, filling an occasional hiatus left by the official reporters of the United States.

The almost unexceptionally favorable tenor of the foreign reports is very noticeable and gratifying.

The Editor is very greatly indebted to Mr. R. H. Buel, for assistance in collating information relating to earlier international exhibitions here given, and to his colleague, Prof. Edward Wall, for assistance in editorial work.

Messrs. Adolph Sorge, M. E., and Theo. F. Koezley, M. E., both recently of the Stevens Institute of Technology, have assisted the editor in making the German translations, and Mr. and Mrs. F. T. Thurston have rendered essential aid in collating the abstracts given from French reports, and in translation.

Delay in the preparation of some of the reports prevented the commencement of the work of editing and of publication as early as was desirable, and their rapid passage through the press was largely due to the active exertions and cordial co-operation of the Hon. A. M. Clapp, Congressional Printer, Mr. H. H. Clapp, chief clerk, and of Mr. H. T. Brian, the indefatigable foreman of printing.

R. H. THURSTON.

THE INTERNATIONAL EXHIBITION AT VIENNA; ITS ANTECEDENTS, ITS PROGRESS, AND ITS RESULTS.

EARLIER EXHIBITIONS.

1. ORIGIN OF INDUSTRIAL EXHIBITIONS.—Before giving a detailed account of the origin, organization, and administration of the Vienna International Exhibition of 1873, and of the part taken by the United States therein, and the results attained, it is considered advisable to glance back at earlier exhibitions and to note the origin and growth of this now fully recognized method of assisting the development of industries and material progress.

2. FAIRS OF THE MIDDLE AGES.—Industrial exhibitions, as exhibitions purely, are of comparatively recent date. Exhibitions for the purpose of effecting sales of the productions placed on view have an origin which antedates modern history.

The latter class of industrial gatherings were formerly called "fairs," (Latin *feria*, holiday,) and were held at stated intervals and in certain localities in the earliest periods of civilization, both in Asia and Europe. They are supposed to have originated in religious gatherings, which first gave an opportunity for the exhibition and sale of wares to large numbers of people. The Greeks and Romans have left accounts of many such fairs. The German name "messen," from mass, also indicates this derivation of the custom as well as of the name.

So important did these institutions become, that, in later times, special courts were established for the consideration of questions of law and equity arising at fairs. Many special privileges were enjoyed at these fairs, and they always afforded opportunities for the sale of goods which could be secured nowhere else.

3. DATE OF THE ORIGIN OF FAIRS.—Fairs were instituted in France and in Southern Europe about 1,300 years ago. Among the more celebrated of the earlier were those of St. Denis, instituted by Dago-

bert, A. D. 629, and Aix-la-Chapelle and Troyes, dating from about A. D. 800. A little later, A. D. 886, they were introduced into Great Britain by Alfred the Great. At the end of the tenth century they had become well established and very common throughout Northern Europe. Attendant, as they were at first, upon religious festivals, they were frequently held on the estates of the church.

4. FAIRS IN GREAT BRITAIN.—The priory St. Bartholomew received a patent from Henry I, A. D. 1133, permitting the establishment of an annual fair continuing three days, and later fifteen days, commencing on the day appropriated to their patron saint, and this fair was sustained until about 1855, when it was discontinued. The English fair at Weyhill is noted for its display of sheep; that of St. Faiths, near Norwich, is distinguished by the numbers of Scotch cattle exhibited and sold; at the fairs of Ipswich are sold lambs in August, and butter and cheese in September. Cattle-fairs are held at Ballinasloe, Ireland, and Donnybrook fair has long been celebrated for the jollity and pugnacity which distinguish its visitors.

5. FRENCH FAIRS.—In France the fair of St. Denis was discontinued in 1789, as were several other of the then most important French fairs, after the establishment of permanent markets. That of Beaucaire, held during one week in July of each year, was instituted about six hundred years ago, and has, in later years, attracted 200,000 visitors from all parts of Europe, and even from Asia and Africa, the sales reaching, it is stated, nearly 25,000,000 francs each season. The fair of Guibray has been in existence about eight centuries; it is a great market for wools, woolens, and fine horses.

6. OTHER EUROPEAN FAIRS.—Fairs are still held in Holland, and they serve not only as means of securing extensive trade, but they are enjoyed by the people as important holidays. Germany is noted as the modern home of this peculiar institution. The principal are those of Leipsic, dating from the twelfth century, which are held three times in each year—at New Year's, Easter, and Michaelmas; Frankfort-on-the-Main; Frankfort-on-the-Oder; and Brunswick.

The great Russian fair of Nizhni-Novgorod is held, in January, on the river, which is then frozen over and the ice is capable of bearing very heavy loads. In July another fair is held, principally for the sale of horses; and the August fair, which continues twenty-five days, is the largest in the world, the sales amounting to many millions of dollars.

7. FAIRS IN ASIA AND AMERICA.—Asia has several annual fairs of great importance. That held at Mecca, when the annual pilgrimages take place, is one of the most extensive. A fair of equal magnitude is held in India, at Hurdwar, on the Ganges, where a quarter of a million people assemble annually.

On the western continent no such great assemblages are known. The Mexican fairs, in early times, were of considerable importance, that held at the city of Mexico frequently attracting many thousands of people.

8. CHANGE OF CHARACTER.—In later years these fairs have been less required as a means of promoting commerce, as the facility with which buyers and sellers can now travel to meet each other enables that object to be accomplished far more easily than in earlier times, and permits trade to be carried on with regularity and convenience throughout the year. Those products of manufacture, which were formerly made up in quantities through the greater portion of the year, to be wholly sold during the few days of the fairs, are now continuously produced, and their sale goes on uniformly and promptly at all seasons.

9. INDUSTRIAL EXHIBITIONS.—This change in the methods of commerce has led to the institution of industrial exhibitions, at which the object is less to procure the sale of exhibited articles than to make visitors familiar with their character and value, and to inform them of the place of manufacture and sale, with the ultimate result of bringing purchasers to the manufacturer or the merchant and instituting a regular trade.

10. FRENCH EXHIBITIONS.—The first of these exhibitions is supposed to have been held in France, at the suggestion of the Marquis d'Avèze, at the Maison d'Orsay, and was simply an exhibition of such articles of manufacture as could be conveniently gathered by the managers from among neighboring shops and manufactories. Its partial success led to a second attempt in the same year, which, conducted on a larger scale and presenting a far greater variety, was much more important and successful. So successful was it that Napoleon, then Consul, encouraged the next attempt, in 1802, which was so perfectly successful that regular triennial exhibitions were instituted and continued nearly up to the present time, except when interrupted by political changes.

Similar exhibitions were held in Great Britain by the Royal Dublin Society nearly a half century ago, and the Mechanics' Institute (now the American Institute) of New York commenced holding its exhibitions a little later in the United States. Such exhibitions soon became regularly recognized institutions in many cities of all countries.

11. ORIGIN OF INTERNATIONAL EXHIBITIONS.—The success of these exhibitions, which were purely local in character and usually of somewhat moderate extent, finally led to the attempt to institute industrial exhibitions at which all nations should be represented. The first of the properly so-called international exhibitions was that which was held under the direction of the London Society of Arts. It was proposed immediately after the French local exhibition at Paris in 1844, but the plan was not matured until 1849, when the scheme was first made public by Prince Albert, then the president of the society. As early as 1854, however, M. Boucher de Perthes had recommended the holding of a French *exposition universelle.* No action, however, seems to have been taken, and the plan did not succeed.

12. EARLIER INTERNATIONAL EXHIBITIONS.— Exhibitions which seem entitled to the name of international, as distinguished from those in

which provision is only made for the display of local products and manufactures, have been held as follows:*

I. At London, in 1851.
II, III. At Dublin and New York, in 1853.
IV. At Paris, in 1855.
V. At London, in 1862.
VI. At Paris, in 1867.
VII. At Vienna, in 1873.

I.—The First International Exhibition, London, 1851.

13. *Inception.*—In 1849, the council of the Society of Arts, of England, recommended that the yearly exhibition of that society, to be held in 1851, be made the first of a series of displays which should "culminate every fifth year in a great national exhibition, embracing *all* manufactures." To this end they requested the government to aid them in providing a permanent building suitable for such displays. In the same year, His Royal Highness the Prince Consort, then president of the Society of Arts, proposed that the national display be enlarged to a universal exhibition. The matter was then brought to the notice of the government by a letter from the Prince Consort to the home secretary, and, the response being satisfactory, the Society of Arts proceeded to carry the idea into effect. They first made a provisional arrangement with the Messrs. Munday, who agreed to advance the money likely to be required for the building; and they organized meetings in the principal towns of Great Britain, by which they received assurance of support from a large number of influential citizens. They also directed Mr. Digby Wyatt to prepare an account of the methods pursued by the French in their former national exhibitions.

14. *Preparations.*—Upon presenting a report of their proceedings to

*In the preparation of the accounts of these exhibitions, free use has been made of the following publications:

I. *Scientific Record of the Great Exhibition of* 1862. London: Longman, Green, Longman & Roberts.

II. *Official Illustrated Catalogue of the International Exhibition, London,* 1862. Printed for Her Majesty's commissioners.

III.—*Reports of the Juries, Exhibition,* 1851. London: Printed for the Royal Commission.

IV.—*Official Catalogue of the New York Exhibition of the Industry of All Nations.* 1853 George P. Putnam & Co.

V.—*Art and Industry as represented in the Exhibition at the Crystal Palace, New Y* 1853-'4. Redfield.

VI.—*Visite a L'Exposition Universelle de Paris, en* 1855. Libraire de L. Hachette et Cie.

VII.—*L'Exposition Universelle de* 1867. Paris: Librairie de L. Hachette & Cie.

VIII.—*Reports of the United States Commissioners to the Paris Universal Exposition.* 1867 Washington: Government Printing Office, 1870.

IX.—*The Engineer.* London, 1872, 1873.

X.—*Engineering.* London, 1873, 1875.

XI.—*Journal of the Franklin Institute.* Philadelphia, 1874, 1875.

the government, the Queen, early in 1850, issued a royal commission providing for an inquiry into the best mode of conducting the proposed exhibition. Under this commission appointments were made both by the government and by the Society of Arts, the latter being confirmed by the Queen's commissioners.

From this time the work was carried on under the royal commission. They first decided to cancel the provisional offer of the Messrs. Munday, believing it to be more appropriate to obtain the necessary funds by voluntary contributions. A public subscription-list was opened, but it was found impossible to raise sufficient money by this means, and in June, 1850, a guarantee-fund for $1,000,000 was suggested.

The commissioners soon afterward obtained a royal charter of incorporation, and were able to borrow the necessary funds from the Bank of England on the security of the guarantee deed. The amounts obtained by subscription and from loans were as follows:

From subscriptions	$386,080
From loans	158,160
	544,240

The place chosen for the exhibition was in Hyde Park; and permission to use the land was obtained from the government. Plans for a building were solicited early in 1850, and two hundred and thirty-three were sent in by various competitors. None were accepted by the commission, who proceeded to make their own plan, and this was subsequently set aside for one proposed by Sir Joseph Paxton. This edifice was to be built chiefly of glass and iron.

15. *Buildings.*—The contract for a building in accordance with this plan was made with Messrs. Fox, Henderson & Co., on the 26th of July, 1850. Its erection was commenced early in September, 1850; and the exhibition was opened on May 1, 1851, making the working time about one hundred and ninety days.

In the general design the following features were kept in view:

1st. That there should be a main avenue extending the whole length of the building, wider and higher than any other part, with the exception of a single transverse avenue.

2d. That there should be a small number of entrances, for convenience of supervision, and numerous exits, and that the business offices should be near the principal entrance.

3d. That the arrangement of the other avenues and transverse gangways should be such as to allow visitors to go over the whole building without visiting any part twice, to render any particular point readily accessible from the main avenue, and to insure, as far as possible, the movement of persons in regular currents.

4th. That the distance between posts should be either the width of the longitudinal avenues or a multiple of this width, and that the drain-

age of the roof should be effected in uniform areas, through a sufficient number of hollow columns.

The building was three stories in height, and the general dimensions are given below:

Length, 1,840 feet.
Width, 408 feet.
Projection on north side, 936 feet long, 48 feet wide.
Width of main avenue, 72 feet.
Width of other avenues, 24 and 48 feet.
Height of dome at center, 104 feet.
Height of nave, 64 feet.
Height of aisles, 24 feet.
Height of gallery above floor, 23 feet.
Area of ground-floor ..... 772,784 square feet.
Area of galleries ..... 217,100 square feet.

989,884 square feet.

The original contract-price for the building was $388,350, with the understanding that the building was to be sold at the conclusion of the exhibition and the proceeds given to the contractors. Much additional expense, however, was incurred during its construction, and the price finally awarded was $694,810. By the sale of the building $365,018 was realized, making the total amount received by the contractors $1,059,828.

The building, as has already been mentioned, was constructed chiefly of iron and glass. It was divided into avenues by rows of hollow cast-iron columns, connected by three horizontal rows of girders; all, with the exception of those at the intersection of the nave and transept, had a uniform depth of 3 feet. These long lines of girders were connected together at numerous points by transverse girders, which served as supports for the floor-beams of cross-galleries.

The building was inclosed by dividing each space between the outer rows of columns into three panels, filling in the lower story with boarding, and fitting sashes to the panels above. Ventilation was effected by inserting metal louvres in the lower floor, and the right of searching for valuables was sold when the building was taken down.[1]

16. *The exhibition.*—The exhibition was opened on the 1st of May, 1851, and closed on the 15th of October in the same year. After the conclusion of the exhibition the building was purchased by the "Crystal Palace Company," and was taken down and re-erected at Sydenham in the summer of 1852.

Charges for admission.—Season-tickets for gentlemen, $14.60; after the 1st of August, $7.30. Season-tickets for ladies, $9.73; after the 1st of August, $4.87. Single admission, May 2 and 3, $4.87; from May 5 to 24, inclusive, $1.21; after May 26, Mondays, Tuesdays, Wednesdays, and Thursdays, $0.24; Fridays, $0.61; Saturdays, $1.22. Total number of visitors, 6,039,195.

Receipts from admission-fees and subscriptions	$2,952,585 65
Expenses	1,424,882 00
Balance	1,527,703 65

The total number of exhibitors was 13,938; 6,556 were from foreign countries, and 7,382 from Great Britain.

17. *Classification.*—In the classification of the exhibits they were divided into four great departments, and these, in turn, were subdivided into thirty classes, as follows:

RAW MATERIALS, (4 classes.)

I. Mining, quarrying, metallurgical operations, and mineral products.
II. Chemical and pharmaceutical processes and products generally.
III. Substances used for food.
IV. Vegetable and animal substances chiefly used in manufactures, as implements or for ornaments.

MACHINERY, (6 classes.)

V. Machines for direct use, including carriages and railway and naval mechanism.
VI. Manufacturing; machines and tools.
VII. Civil engineering; architectural and building contrivances.
VIII. Naval architecture and military engineering; ordnance, armor, and accoutrements.
IX. Agricultural and horticultural machines and implements.
X. Philosophical instruments and processes depending upon their use; musical, horological, and surgical instruments.

MANUFACTURES, (19 classes.)

XI. Cotton.
XII. Woolen and worsted.
XIII. Silk and velvet.
XIV. Manufactures from flax and hemp.
XV. Mixed fabrics, including shawls, but exclusive of worsted goods, (class XII.)
XVI. Leather, including saddlery and harness, skins, fur, feathers, and hair.
XVII. Paper and stationery, printing and book-binding.
XVIII. Woven, spun, felted, and laid fabrics, when shown as specimens of printing or dyeing.
XIX. Tapestry, including carpets and floor-cloths, lace, and embroidery, fancy, and industrial works.
XX. Articles of clothing for immediate personal or domestic use.
XXI. Cutlery and edge tools.
XXII. Iron and general hardware.

XXIII. Working in precious metals and in their imitations, jewelry, and all articles of virtu and luxury, not included in all other classes.

XXIV. Glass.

XXV. Ceramic manufactures, china, porcelain, earthenware, &c.

XXVI. Decorative furniture and upholstery, including paper-hanging, *papier-maché*, and japanned goods.

XXVII. Manufacture in mineral substances used for building or decoration, as in marble, slate, porphyries, cements, artificial stones, &c.

XXVIII. Manufactures from animal and vegetable substances, not being woven or felted, or included in other sections.

XXIX. Miscellaneous manufactures and small wares.

FINE ARTS, (1 class.)

XXX. Sculpture, models, and plastic art.

18. *The juries.*—The appointment of juries to examine the various exhibits, and the principles governing the granting of awards at this the first exhibition of the industry of the world, are matters of peculiar interest, the more so because the rules laid down by the royal commissioners possess many novel features.

The ordinary rule then, and even now, to a great extent, prevailing at national and local exhibitions, was to institute a direct comparison between the merits of articles of the same kind, and to make the awards to the best exhibits of a class.

In the present instance it was deemed advisable to avoid any such comparison, and to make the awards in recognition of peculiar merit, to be decided by a standard. Thus, supposing an article on exhibition combined "utility, beauty, cheapness, adaptation to particular markets," or similar features, which were considered of importance, a medal might be awarded in recognition of the fact without implying that this article was better than another, which might possess meritorious features distinctive to itself. It will be evident that there are great difficulties in the application of such a rule, but it appears to have been carried out with considerable success by the juries on this occasion. In making up the juries, each was composed, as far as possible, of an equal number of British and foreign jurors. Foreign governments were invited to nominate the jurors from their countries, and British towns sending a considerable number of exhibits were to furnish the names of persons fitted to serve.

The number of jurors assigned to any class varied in accordance with its relative importance and the number of exhibits which it contained. Any jury was authorized to call in associates to assist by their technical knowledge. The total number of jurors was 323, and of associate jurors, 63.

The chairmen of all the juries were formed into a council, to which all matters of importance were referred.

19. *Awards.*—The medals were of two kinds. The larger of the two

was known as the "council medal;" it could only be conferred with the approbation of the council of chairmen after the award had been recommended by the jury of a class and confirmed by the juries of all allied classes. The council medal was awarded for "novelty of invention or adaptation or any peculiarity in the mode of manufacture," as distinguished from excellence of workmanship or the like.

The second medal, known as the "prize medal," was awarded by a decision of a jury of a class, confirmed by the juries of all allied classes. The features for which this award was to be made are summarized below, from the "Instructions from the council of chairmen to the judges."

(1.) Skill and excellence in the known modes of obtaining and adapting raw materials and produce—comparative excellence in the quality.

(2.) Adaptability to use, economy in first cost, durability, economy of maintenance, excellency of workmanship, strength.

(3.) In all instances where it was considered necessary, especially in the case of agricultural machinery, actual trials of the articles were made.

In addition to these medals, the juries were authorized to make "honorable mention" of articles possessing considerable merit, but not sufficient to be granted medals, and in special cases awards of money were permitted to be made to deserving exhibitors.

The exhibition here briefly described is generally acknowledged to have fully realized the views of its projectors, and to have proved successful, not only as a commercial enterprise, but also as the first public illustration of the state of civilization and of the industries of the world.

II.—International Exhibition at Dublin, 1853.

20. *Inception.*—The Royal Dublin Society had held national industrial exhibitions triennially since 1835. While making preparations, in 1852, for the exhibition of 1853, they received a communication from Mr. William Dargan, a well-known contractor, to the following effect:

21. *Buildings.*—Mr. Dargan agreed to advance $97,000 for the erection of a suitable building, on condition of naming a number of the officers of the exhibition, of receiving the building at the close, and being paid all the net proceeds under $97,000, with 5 per cent. interest added, the valuation of the building being reckoned as part of the money to be paid to him. The offer was accepted, and advertisements for plans were issued. The successful design was furnished by Sir John Benson, of Cork, and the building was erected under his direction.

The building was located on the grounds of the Royal Dublin Society. It consisted of five parallel, arched, and dome-roofed halls. The building had two stories, and the general dimensions are given below:

Central hall, 425 feet long, 100 in width, and 105 feet high; northern and southern halls, each 375 feet long, 50 broad, and 65 high.

Hall for the fine arts, 325 feet long, 40 broad, and 38 high; hall for machinery in motion, 450 feet long, 40 broad, and 46 high.

Besides this, some of the courts were roofed over, and the total superficial area was about 265,000 square feet. The building was constructed principally of timber, the sky-lights being glazed with finely corrugated plate-glass.

22. *The exhibition.*—While the building was in course of erection the executive committee decided to make the exhibition international.

The erection of the building was commenced in August, 1852, and the exhibition was opened on the 12th of May, 1853. No medals or premiums were granted for articles in this exhibition.

The total number of visitors was about 1,000,000, and the receipts from admission-fees about $229,000. The cost of the building was much greater than had been anticipated, reaching nearly $290,000, and the building, when disposed of, only brought $77,000. When the building was taken down, it was found that very little of it was available for use in other structures, on account of the poor quality of the material, and from the fact that so much of it consisted of curved pieces, only suitable for buildings on the same large scale as that in which it had already been employed.

III.—Exhibition of the Industry of all Nations at New York, 1853.

23. *Inception.*—In the latter part of 1851 several prominent gentlemen in the United States formed an association for the purpose of inaugurating an international exhibition the following year, proposing to raise the necessary funds by soliciting subscriptions to the stock of the company. On the 3d of January, 1852, the corporation of the city of New York gave the association a free lease for five years of Reservoir square, bounded by Fortieth street, Sixth avenue, Forty-second street, and the Croton reservoir, on condition that the building to be erected should be composed of iron and glass, and that the price of a single admission-fee to the exhibition should not exceed 50 cents.

On the 11th of March, in the same year, the company was incorporated by the New York legislature, under the title of the "Association for the Exhibition of the Industry all Nations." The charter conferred upon the company, for the term of five years, the right to issue stock to the amount of $200,000. This was afterward increased to $500,000. They were also authorized to confer prizes and awards. The price of admission was limited to 50 cents, and it was provided that, for one day at least, the children from the public schools and charitable institutions of New York City should be admitted free of charge. It was provided, moreover, that the net proceeds of one day's exhibition should be devoted to the relief-funds of the fire departments of New York and Brooklyn.

The United States Government agreed to make the exhibition build-

ing a bonded warehouse, and the representatives of foreign governments in this country signified their hearty approval of the undertaking. No official indorsement of the scheme was given by the United States Government to foreign powers, but instructions were issued by Mr. Webster, then Secretary of State, to the representatives of the United States abroad, suggesting that they should aid the association by all means in their power.

This exhibition, therefore, although countenanced and aided by the United States Government, was the result of private enterprise, similar to that employed in any ordinary commercial speculation.

24. *Buildings.*—Soon after incorporation, the association invited plans for a building, and, out of a number that were received, a choice was made of those submitted by Messrs. Carstensen and Gildmeister, and an architectural staff, consisting of Messrs. C. E. Detmold, Horatio Allen and Edmund Hurry, was appointed to supervise the execution of the work.

The erection of the building was begun in October, 1852, the first column being raised on the 30th of that month. The completion of the work was delayed considerably after the expected time, and the opening of the exhibition, having been several times postponed, finally occurred on the 14th of July, 1853. At this time, the work upon the building was far from being done, and it was not thoroughly inclosed and protected against the weather. The President took part in the opening exercises.

The general form of the building was that of a Greek cross, surmounted by a dome in the center. The triangular spaces between the arms of the cross were roofed over at the first story, for the purpose of obtaining additional space. There were two central naves in the building, with aisles on either side, and there were galleries over these aisles, connected at the ends. At the intersection of the nave was an octagonal space 100 feet in diameter, immediately beneath the dome. An addition was made to the building, occupying all the space between it and the reservoir, and this was carried up to the second story with a diminished width. An octagonal tower was placed at each corner of the building.

The dome, which was the most striking detail, was 100 feet in diameter, its springing line being about 70 feet from the floor. The building was supplied with water and lighted by gas.

The principal dimensions not previously noted are given below:

DIMENSIONS OF BUILDING.

Width of naves, 41 feet 5 inches.
Width of aisles, 54 feet.
Width of lower story of annex, 75 feet.
Width of upper story of annex, 21 feet.
Length of both stories, 451 feet.

Length of naves, 149 feet 5 inches.
Distance from principal floor to gallery-floor, 24 feet.
Distance from principal floor to ridge of nave, 67 feet 4 inches.

Area of first floor	157,195 square feet
Area of second floor	92,496 square feet
Total area	249,691 square feet.

25. *Classification, awards.*—The classification of exhibits adopted was similar to that of the London International Exhibition in 1851.

In the allotment of space, one-fourth of the building was devoted to the exhibits of the United States; one-fourth was occupied by exhibitors from Great Britain and Ireland; one-fourth by Germany, France, and Belgium, and the remainder by the other exhibitors, including Austria, Holland, Switzerland, Italy, the British Possessions, Sweden and Norway, Denmark, Mexico, Turkey, France, and Hayti.

In making awards for meritorious exhibits, the precedent established by the royal commission of the exhibition of 1851 was followed.

The awards consisted of two classes of medals, silver and bronze, and an honorable mention.

26. *Juries.*—The organization of the juries and the arrangement of the details of their work was intrusted to Prof. B. Silliman, jr., and Messrs. B. P. Johnson, and Samuel Webber, who were styled Commissioners of Juries. It was desired to obtain a due proportion of the jurors from foreign countries, but the attempt was only partially successful, all but 10 of the 201 jurors being residents of the United States. Many of these resident jurors, however, were of foreign birth, and well fitted to represent the interests of foreign exhibitors.

The exhibits were arranged in 31 classes, and there were 15 juries, several classes, in most instances, being given to a single jury.

After the conclusion of the exhibition the crystal palace was used for local displays and amusements. It was destroyed by fire in 1858, at which time the twenty-ninth annual exhibition of the American Institute of the city of New York was in progress there.

The exhibition of 1851 was not financially successful; and the fact that it was a private speculation, prevented foreign nations from sending representative commissions. It was also mainly on account of this fact that some unpleasant feeling was created, after the close of the exhibition, by the seizure of foreign exhibitors' goods for the debts of the association.

In spite of these drawbacks, the exhibition of 1851 was productive of great good.

IV.—Universal Exposition at Paris, 1855.

27. *Inception.*—French expositions, which have excited the admiration of all civilized nations by their complete system of organization, and by the interesting character of their displays, were inaugurated in 1798 under the Directory, and were occasionally held afterward.

On the occasion of the eleventh exposition, in 1849, it was proposed by the then President, Napoleon, to invite all nations to participate in a friendly competition with the French. The proposition was not favorably received by the French people; and almost at the same time the Prince Consort of England presented the same idea to the English nation.

It has already been shown how well this suggestion was carried into effect. After this, it was decided in France that the next exposition, to be held in 1855, should be international in character; and, as early as 1852, the French Emperor selected a site for the building, and ordered the erection of a permanent structure in the grand square of the Champs Elysées, "to receive national exhibitions, and to serve for great public ceremonies, and for civil or military fêtes."

A company was organized which contracted to erect the building in return for a lease of the site for thirty-five years, and for the profits that might be derived from exhibitions.

28. *Buildings.*—The original plans for the structure were drawn by MM. Viel and Desjardins, and a contract for the work was signed by MM. York et Cie., with the proviso that they might make such changes in the plan as seemed advisable, "provided that they neither altered the dimensions, the solidity, nor the artistic aspect of the building, which was to be considered as a national monument."

The plan, as first devised, contemplated only the construction of a permanent industrial palace, with a separate building for the display of works of fine art. On account of the unexpected demands for space, however, it was found necessary to provide additional accommodation in temporary structures, so that the buildings, as finally arranged, comprised the following:

(1.) The industrial palace, about 827 feet long by 354 feet in width. Its general form was that of a parallelogram, with projections containing the entrances and staircases to the galleries, at the corners, and in the center of the principal fronts.

(2.) The "panorama" of the Champs Elysées was surrounded by a circular gallery constructed of timber, and roofed in three concentric spans, thus dividing the space between the panorama and the outer wall into three annular galleries. The outer gallery, 20 feet in width, formed the "buffet." The width of the intermediate gallery was 42 feet, of the other, 20 feet, and the diameter of the interior circle of the panorama was 165 feet. A covered passage connected this building with the industrial palace.

(3.) There were three buildings, constructed of timber, in the garden. These were designed for the exhibition of agricultural implements and products.

(4.) A covered lattice bridge passing over the *Chaussée du Cours la Reine*, connected the panorama with the annex—an enormous building, 3,832 feet long, and 89 feet wide.

The area covered by these buildings was distributed as follows:

	Square feet.
Industrial palace	545,934
Annex	446,955
Panorama and passages	97,116
	1,090,005
Gardens and other inclosed grounds	237,648
	1,327,653

(5.) The palace of fine arts was a detached building having an area of 173,768 square feet. Adding this to the surface already noted, it will be seen that the total space available for exhibits was 1,501,421 square feet, of which more than one and a quarter million square feet were covered. The total space occupied by exhibitors was about 1,100,000 square feet, and there were 20,788 exhibitors; the average space occupied by each was nearly 53 square feet.

29. *Arrangement.*—In the arrangement of the exhibits, all the machinery, with the exception of that relating specially to agriculture, was placed in the annex, and in this building were also exhibited natural products, agricultural productions, paper, leather, chemical products, substances used as food, articles manufactured from leather, and instruments of precision. In the panorama were displayed some of the richest treasures of France, and productions of the imperial factories. The larger of the agricultural buildings was principally occupied with French machinery. One of the smaller buildings was devoted to wagons and carriages, including railway rolling-stock.

At the end of these buildings was a display known as "*l'Exposition à bon marché*" in which were shown articles remarkable for their low price and excellent quality, particularly suitable for persons of moderate means. A building was also shown, or rather a collection of designs, which were offered as a solution of the problem of providing cheap and comfortable homes for the working classes.

There were numerous other small buildings in the grounds surrounding the panorama, containing a variety of interesting exhibits, and the garden itself was an object of especial admiration.

All the exhibits, with the exception of works of art, were displayed in the great industrial palace.

30. *Classification.*—In the arrangement of the exhibits, they were divided into 8 groups and 31 classes, which are represented in detail as follows:—

GROUP I: (3 classes.)

Industries for the extraction and introduction of raw materials.

I. Mining and metallurgy.

II. Rural arts, hunting, fishing, and products obtained without culture.

III. Agriculture, vegetables, and animals.

GROUP II; (4 classes.)

Industries illustrating special applications of mechanical forces.

IV. General application of mechanism to industrial purposes.
V. Machinery for railways and other means of transportation.
VI. Machinery and materials for special industries.
VII. Machinery and materials used in the manufacture of textile fabrics.

GROUP III; (4 classes.)

Industries depending upon physical and chemical agents or connected with science and instruction.

VIII. Arts of precision, philosophical instruments.
IX. Industries for the economical use of heat, light, and electricity.
X. Chemistry, dyeing and printing, manufacture of paper, leather, India rubber, &c.
XI. Preparation and preservation of substances used as food.

GROUP IV; (3 classes.)

Industries especially relating to the learned professions.

XII. Hygiene, pharmacy, medicine, and surgery.
XIII. Naval and military art.
XIV. Civil engineering.

GROUP V; (4 classes.)

Manufacture of mineral products.

XV. Manufacture of steel and tools.
XVI. Ordinary metal-working.
XVII. Jewelry, trinkets, works in bronze.
XVIII. Glassware and porcelain.

GROUP VI; (5 classes.)

Manufacture of textile fabrics.

XIX. Cotton manufactures.
XX. Woolen manufactures.
XXI. Silk manufactures.
XXII. Flax and hemp manufactures.
XXIII. Manufactures of hosiery, carpets, small wares, embroidery, and laces.

GROUP VII; (4 classes.)

Furniture and decoration, fashions, industrial designs, printing, and music.

XXIV. Industries relating to furniture and decoration.
XXV. Clothing, fashions, and fancy goods.

XXVI. Drawing and modelling, applied to industrial pursuits, type-printing and engraving, photography, &c.

XXVII. Musical instruments.

GROUP VIII; (3 classes.)

Fine arts.

XXVIII. Painting, art-engraving, lithography.

XXIX. Sculpture, die-cutting, &c.

XXX. Architecture (as a fine art.)

NOT GROUPED.

XXXI. Productions relating to domestic economy.

The industrial palace consisted of a central nave or hall 157½ feet wide, with two parallel halls, one on either side, each 78¾ feet in width, and two halls of the same width as the latter, at right angles to the central hall. Each hall was covered by an arched roof in a single span. The engines and pumps, with steam, were placed in a building contiguous to the annex. The palace of fine arts was constructed mainly of timber, the roof being covered with zinc, and piereed with numerous sky-lights. The building was lighted entirely from the roof, and the rays of light passed from the sky-lights through a glass ceiling which was considered to have produced a very good effect, besides serving as an additional protection to valuable paintings by insuring them against injury by accidental leakage from the sky-lights.

31. *The exhibition.*—The exhibition was opened on the 15th of May, 1855, and closed on the 15th of November. During this time, the number of visitors was about four and a half millions. The exhibition seems to have been carried on without regard to expense, and with little expectation of obtaining immediate pecuniary return.

The price of admission, on stated occasions, was as low as four cents, and, on certain days, admission was free.

32. *Awards.*—Awards were freely distributed, as will be seen by a comparison of the following statement with the number of exhibitions previously given:

Decorations of the Legion of Honor	40
Grand medals of honor	112
Medals of honor	268
Medals of the first class	2,367
Medals of the second class	3,987
Medals of the third class	77
Honorable mention	4,222
Total	11,073

Many decorations of the Legion of Honor were bestowed also upon commissioners and on jurors. Indeed, France succeeded, on the occasion of

her first international exposition, in establishing an enviable reputation for the princely hospitality with which she greeted foreign nations.

The following is a brief statement of the expenses incurred on account of the exposition:

BUILDINGS.

Industrial palace	$2,524,000
Annexe	777,000
Panorama	194,000
Total	3,495,000

Expenses, exclusive of buildings, about $2,201,000; receipts, about $574,000.

V.—International Exhibition, London, 1862.

33. *Inception.*—The great success of the exhibition of 1851, of which the conception was due to the Society of Arts, induced this society in 1858 to commence preparations for attempting its repetition on a grander scale, in 1861. The time for the proposed exhibition was afterward changed to 1862.

The commissioners of the exhibition of 1851 had used the surplus remaining in their hands to purchase a considerable tract of land at Kensington, and had leased a portion of it to the Royal Horticultural Society for an exhibition garden. In March, 1860, the Society of Arts addressed the commissioners of 1851, asking if they could obtain the use of these grounds for an international exhibition in 1862, provided they succeeded in obtaining the money necessary by subscriptions to a guarantee fund. The answer was favorable, and they immediately issued a public call for subscriptions to the amount of $1,120,000, to form a guarantee fund. They proposed to place the management in the hands of five commissioners, to be appointed by the government. In their appeal to the public they stated that, since the exhibition of 1851, great advances had been made in nearly every branch of industry, and that means of transportation had been increased to such an extent that it was reasonable to expect that the proposed exhibition would be vastly superior to any that had preceded it, and would receive a great increase of patronage by visitors.

Early in June, 1860, the whole amount called for had been subscribed, and the subscriptions to the guarantee fund were afterward increased to $2,174,595. After considerable discussion and many changes, the arrangement made with the commissioners of 1851, for the use of their ground, was as follows:

They agreed to give a lease of the necessary ground, rent free, for the purposes of the exhibition, at the conclusion of which, all buildings of a temporary character were to be removed; but if the profits of the exhibition were sufficient to justify the expenditure of a sum not ex-

ceeding $243,000, for decorating and improving a permanent portion of the buildings in a manner that was satisfactory to the commissioners, they would grant a lease of the land for ninety-nine years, on receipt of $48,665.

At the request of the Society of Arts, the Queen appointed five commissioners to undertake the management of the exhibition, and gave them a charter of incorporation, dated February 14, 1861, as soon as all the signatures to the guarantee deed were obtained. The Bank of England agreed to advance the necessary funds, on the security of this deed.

34. *Buildings.*—The commissioners for the exhibition of 1862 did not invite a general competition in plans for the building, but accepted, with some modifications reducing the cost, those presented by Captain Francis Fowkes, of the Royal Engineers, which it was estimated could be erected for the sum of $2,092,595. The contract for the work was taken by the Messrs. Kelk and Messrs. Lucas, with the stipulation that it should be completed by February 12, 1862, and with the following agreement in regard to price:

The contractors were to remove the building at the conclusion of the exhibition, and were to receive $973,300, if the profits of the exhibition were less than $1,946,600; but if the profits were equal to or exceeded this amount, the rent paid to the contractors was to be $1,459,950, or the commissioners were to have the option, instead of renting the building, of purchasing it for $2,092,595.

The main building, which was intended to be permanent, as erected under this contract, was constructed with brick walls, and consisted of the main portion of the structure, 1,150¾ feet long and 50 feet in width, two stories in height, together with two wings, each 750 feet long and 25 feet wide. The upper stories of the building were devoted to the display of works of art, and were lighted very effectively by continuous skylights in the roofs. Towers were constructed at the ends of the main buildings and of the wings.

35. *The exhibition.*—The exhibition was opened to the public on the 1st of May, 1862, and closed on the 1st of November. During this period, it was opened daily, with the exception of Sundays, at 10 o'clock a. m., and closed at 7 p. m., during the months of May, June, and July, after which it was closed half an hour before sunset. An arrangement was made with the Royal Horticultural Society, by which visitors could be admitted to the garden.

The prices charged for admission are appended: Season tickets, for a single admission to exhibition only, $15.33; season tickets each admitting the holder both to the exhibition and to the horticultural garden, $25.55; admission on the 1st of May to holders of season tickets only; single admission May 2 and 3, $4.87; single admission May 5 to 17, $1.22; single admission May 19 to 31, $0.61, except Saturdays, when it was $1.22: single admission after May 31, Mondays, Tuesdays, Wednes-

Thursdays, $0.24; single admission after May 31, Fridays, $0.61; single admission after May 31, Saturdays, $1.22.

The most important features of the general regulations and preliminary notices are presented below.

The commissioners, after receiving their charter of incorporation, appointed an executive staff and superintendents of the various departments.

36. Classification of Exhibits.

Section I.—(4 classes.)

I. Mining, quarrying, metallurgy, and mineral products.
II. Chemical substances and products, and pharmaceutical processes.
III. Substances used for food.
IV. Animal and vegetable substances used in manufactures.

Section II.—(13 classes.)

V. Railway plant, including locomotive engines and carriages.
VI. Carriages not connected with rail or train roads.
VII. Manufacturing machines and tools.
VIII. Machinery in general.
IX. Agricultural and horticultural machines and implements.
X. Civil engineering, architectural and building contrivances.
XI. Military engineering, armor and accoutrements, ordnance and small-arms.
XII. Naval architecture, ship's tackle.
XIII. Philosophical instruments, and processes depending upon their use.
XIV. Photographic apparatus and photography.
XV. Horological instruments.
XVI. Musical instruments.
XVII. Surgical instruments and appliances.

Section III.—(19 classes.)

XVIII. Cotton.
XIX. Flax and hemp.
XX. Silk and velvet.
XXI. Woolen and worsted, including mixed fabrics generally.
XXII. Carpets.
XXIII. Woven, spun, felted, and laid fabrics, when shown as specimens of printing or dyeing.
XXIV. Tapestry, lace, and embroidery.
XXV. Skins, fur, feathers, and hair.
XXVI. Leather, including saddlery and harness.
XXVII. Articles of clothing.
XXVIII. Paper, stationery, printing, and bookbinding.
XXIX. Educational work and appliances.

XXX. Furniture and upholstery, including paper-hangings and *papier-maché*.
XXXI. Iron and general hardware.
XXXII. Steel and cutlery, and edge-tools.
XXXIII. Works in precious metals and their imitations, and jewelry.
XXXIV. Glass.
XXXV. Pottery.
XXXVI. Manufactures not included in previous classes.

SECTION IV.—(4 classes.)

Modern fine arts.

XXXVII. Architecture.
XXXVIII. Paintings in oil and water-colors, and drawings.
XXXIX. Sculpture, models, die-sinking, and intaglios.
XL. Etchings and engravings.

37. *Organization.*—On the completion of the organization, a circular was sent to every mayor, provost, and chamber of commerce in the United Kingdom, suggesting the appointment of local committees, who should interest themselves in the objects of the exhibition, exert themselves to have the best industries of the country represented, and give publicity in their district to such information as would be useful to exhibitors.

The government was also requested to correspond with foreign powers, inviting them to take part in the exhibition, and to appoint foreign commissioners to represent them. It was decided that all communications with foreign exhibitors should take place through the foreign commissioners, and that no applications for space from foreign exhibitors would be considered, unless they were made by the commissioners representing the country to which the exhibitor belonged. Foreign governments were informed that they were constituted the judges of the fitness of the proposed exhibits, and they were requested to use their efforts to have only the best products of a country forwarded for display.

Each foreign commission was allowed to arrange the exhibits under its charge in such manner as seemed desirable, subject only to the general system of arrangement devised for articles of different classes. In assigning the space to a country, one-half of the total area was reserved for passage-room.

All articles from foreign countries were admitted free of duty, and were allowed to be exported free at the conclusion of the exhibition, the exhibition being made a bonded warehouse, under special regulations of the officers of the customs. The commissioners announced that they did not intend to take any steps to protect inventions and designs.

In regard to exhibits from the United Kingdom, it was provided that only works of industry produced since 1850 would be admitted. Prices were allowed to be placed on objects in the first three classes.

In the Department of Fine Art, it was desired to give the best possible illustrations of modern art, and each foreign country was requested to decide upon a period of time conforming to this condition.

The work of selecting the exhibitors in this department from the United Kingdom was intrusted to a special committee, and the following art institutions were requested to confer with artists who were members of the several societies: Royal Academy, Royal Scottish Academy, Royal Hibernian Academy, Society of Painters in Water-colors, Institute of British Artists, Institute of British Architects.

No prices were allowed to be affixed to any of the works of art exhibited, and no prizes were awarded in this department.

In the apportionment of space, nearly one-half of the total area was reserved for British exhibitors.

38. *Jurors.*—The thirty-six classes of exhibits in the Industrial Department were, by subdivision, increased to sixty-five, and a special jury was appointed for each of these sub-classes. All the medals awarded were of "one class, for merit, without any distinction of degree." In the organization of the juries, each foreign country represented was allowed to nominate one juror for each undivided class in which it had at least twenty exhibitors, and in each sub-class in which it had at least fifteen exhibitors. In the selection of jurors from the United Kingdom, each native exhibitor was allowed to propose three jurors for the class in which he exhibited, and from the list so obtained the commissioners selected the requisite number.

All awards were ordered to be made by the 15th of June, and it was provided that immediately thereafter they should be affixed to the counters of the successful exhibitors. The jurors were allowed to call in experts to aid them, when they deemed it essential.

All awards were submitted to a "council" formed of the chairmen of the thirty-six juries, and, on being confirmed by them, these decisions were made final. The council of chairmen was also charged with the arrangement of the various matters of detail that required adjustment.

The Exhibition of 1862 was generally regarded as having been less successful than the first one, held in 1851. The number of visitors is stated to have been about the same in 1862 as in 1851, and the receipts to have been somewhat less. It is probable that the death of the Prince Consort in the latter part of 1861, and the fact that the Queen was in retirement during the continuance of the Exhibition, were circumstances which detracted largely from the success which had been anticipated.

VI.—Paris Universal Exposition, 1867.

39. *Inception.*—It was decided in 1864, by an imperial decree of the French Emperor, that an international exhibition should be held at Paris in 1867. Early in 1865, communications were sent to foreign governments, inviting them to participate in the exhibition, and informing them that no exhibits from a foreign country would be admitted

unless the invitation had been formally accepted by the government of that country and a commissioner appointed to communicate with the imperial commission on all matters relating to exhibitors from his country.

By an imperial decree approved July 12, 1865, and by supplemental decrees issued shortly after, the general regulations for the management of the exhibition were made known. By these decrees the control was vested in the hands of imperial commissioners, Prince Napoleon being the president, and M. Le Play the general manager.

The Champ de Mars, the great military parade ground of Paris, was chosen as the locality of the exhibition, and to this was added the island of Brillancourt, which was devoted to the display of agricultural implements. It was decided to erect one immense exhibition-building, a single story in height, and to place all the articles in this, with the exception of agricultural displays, live-stock, &c.

40. *Buildings.*—Prince Napoleon, in his report to the Emperor at the close of the Exhibition of 1855, had suggested a new order of arrangement of the articles for future occasions, and his suggestion was carried into effect in the Exhibition of 1867.

The general idea of the arrangement was to dispose similar goods from different nations in such a manner that they could be readily compared and studied. This was accomplished by classifying the goods in the building into seven groups, and constructing seven galleries, in each of which one of the groups was placed.

The general form of the great exhibition was a rectangle with rounded ends, having a length of 1,608 feet, a width of 1,247 feet, and covering an area of 1,708,724 square feet. In the center was a pavilion, surmounted by a dome, for the display of the weights and measures of different countries, and this was surrounded by a garden 545 feet long and 184 feet in width, with a gallery built around it. In addition to the space occupied by the garden, 37,378 square feet were reserved for a promenade, leaving 1,608,025 square feet, which was divided among the countries represented.

The building had but little of the appearance of a palace, being composed of seven concentric galleries, ranged around the central garden. A certain space in each gallery was allotted to the exhibits of a country, and radial avenues extending from the garden divided the spaces of the several nations from each other.

41. *Arrangement.*—The general arrangement of the articles in the various galleries was as follows:

In the gallery surrounding the garden was a display representing the development of the arts in the different countries, and known as the "Gallery of the History of Labor."

The first exterior circle was devoted to GROUP I, *Works of art*, consisting of five classes, as described in "Reports of the United States Commissioners," volume I, Introduction, pages 166–181.

In the second gallery were placed *Materials and their application in the liberal arts*, belonging to GROUP II, which contained eight classes, as described in "Reports of United States Commissioners."

GROUP III, *Furniture and other objects used in dwellings*, was placed in the third gallery. It was divided into thirteen classes. (See reports as above.)

The fourth gallery contained GROUP IV, *Garments, tissues for clothing, and other articles of wearing apparel*, divided into thirteen classes. (See reports as above.)

In the fifth gallery were displayed the articles belonging to GROUP V, *Products, wrought and unwrought, of extractive industries*, consisting of seven classes. (See reports as above.)

Articles belonging to GROUP VI, *Instruments and processes of common arts*, composed of twenty classes, were placed in the sixth gallery. (See reports as above.)

An elevated platform surrounded this circle, from which a good view could be obtained of the machinery beneath.

The seventh gallery was filled with the articles of GROUP VII, *Food, fresh or preserved, in various stages of preparation.* This group was divided into seven classes. (See reports as above.) Beyond this gallery there was a covered promenade, running completely around the building.

In addition to the articles contained in the foregoing groups, there were twenty-two classes of exhibits, arranged in three groups, which were displayed in the buildings and gardens surrounding the main palace.

GROUP VIII, *Animals and specimens of agricultural establishments*, nine classes. (See reports as above.)

GROUP IX, *Live products and specimens of horticultural establishments*, six classes. (See reports as above.)

GROUP X, *Objects exhibited with a special view to the amelioration of the moral and physical condition of the population*, five classes. (See reports as above.)

The classification presented above is well worthy of attention, as it was by many considered to be one of the most complete that has ever been devised for a universal display of art and industry and natural productions.

This arrangement of the exhibits also possesses peculiar advantages. The different galleries were divided, by partitions, into halls, each of which was appropriated to one of the classes of the group occupying any particular gallery. In consequence of this arrangement, the visitor who desired to inspect and study a single class of articles had only to follow the circle in which that class was displayed completely around the building; while, if he wished to devote his attention to the exhibits of a single country, he had only to keep within the space allotted to that country, which was plainly marked out by the radial avenues on either side.

It will be seen that, in the disposal of the different groups, those which might naturally be expected to consist of articles requiring the greatest space for their display were placed in the larger or outer galleries.

As it was impossible to adhere absolutely to the general system just described in the case of countries which had either an exceptionally large or an unusually small representation, additional space was given to the former in the park, while the exhibits from several of the countries having only a limited display were placed together. A large part of the space in the park was taken up by annexes for additional displays, and by representative buildings of the various nations.

Below will be found a statement of the total space occupied by the exhibition, the number of exhibitors from the different countries, and the average space allotted to each.

Total space occupied by exhibitors, square feet 3,559,943
Total number of exhibitors 50,226
Average space occupied by each exhibitor, square feet 70.9
Total space occupied by the exhibition, including promenades, gardens, and restaurants, square feet 5,211,471

Space allotted to different countries.

Country.	Number of exhibitors.	Total space occupied.	Average space occupied by each exhibitor.
		Square feet.	*Sq. feet.*
France	15,025	1,684,500	112
Great Britain and Ireland	6,176	391,228	63.3
Turkey	4,817	43,882	9.1
Italy	4,009	69,909	17.3
Spain	2,644	36,015	13.6
Prussia and Northern Germany	2,249	234,372	104.2
Austria	2,094	195,927	93.6
Belgium	1,853	178,679	96.4
Portugal	1,648	24,643	15
Brazil	1,138	23,713	15
Republics of Central and South America	394		
Hawaii	52		
Russia	1,365	66,564	48.8
Hesse	242	74,811	66.9
Baden	203		
Würtemburg	259		
Bavaria	414		
Switzerland	1,080	71,846	66.5
Roumania	1,056	26,157	24.8
Sweden	605	53,267	52.4
Norway	411		
United States	703	94,299	134.1
Holland	538	72,769	135.3
Greece	480	8,174	17
Denmark	283	15,775	55.7
China	80	63,073	285.4
Japan	139		
Persia	1		
Siam	1		
Rome	172	12,049	70.1
Egypt	14	70,963	5,069
Tunis	1	47,235	3,374
Morocco	13		
Luxembourg	6	71	11.8
Republic of Andorra	1	22	22
	50,226	3,559,943	

42. *Finances.*—The necessary funds for the exhibition were furnished in part by the imperial government, and the remainder was obtained from appropriations made by the municipal authorities of the city of Paris, a guarantee fund which was raised by a private company, and a public subscription. The amounts, so obtained before the exhibition commenced, were as follows:

Government	$1,165,020
City of Paris	1,165,020
Guarantee fund	1,553,360
Public subscription, about	2,000,000
	5,883,400

43. *The Exhibition.*—The erection of the building was commenced on the 3d of April, 1866, and it was sufficiently completed for the reception of goods at the end of the year.

Special water-works, having a capacity of more than 2,500,000 United States gallons per day, were constructed for the supply of the building and grounds. One-half the supply was obtained from a reservoir holding about 1,000,000 gallons, and elevated 105 feet above the level of the grounds, and the remainder was forced directly into the main by pumping-engines under a low head. A complete supplementary system of pumping-engines was provided, to be used in case of accidents.

Special arrangements were made for ventilating the building by mechanical means. Four groups of blowing-engines were employed, forcing through gratings in the floor nearly 25,000,000 cubic feet of air an hour, which was sufficient to change the entire atmosphere of the building every two hours.

The exhibition was formally opened by the Emperor on the 1st of April, 1867, and closed on the 31st of October.

No charge was made for space in the main building or in the park, but each nation was obliged to make the necessary constructions for the division and display of the different classes of exhibits in the palace, and to put up, at its own expense, such buildings as they desired in the park.

In fitting up the allotted space within the building, each foreign commissioner was allowed to use his own plan, subject, however, to the general design arranged by the imperial commission. Each foreign commissioner was also permitted to make his own contracts for work, or to have it done by the Imperial Commission at a fixed price.

All articles sent by foreign exhibitors were admitted duty free, the exhibition building being considered a bonded warehouse. On the arrival of the goods in France, each commission was expected to make the necessary arrangements and contracts for their transportation to the exhibition, and for the disposal of the packing-cases.

The Imperial Commission engaged to drive the main lines of shafting for machinery in motion, requiring the exhibitors to furnish the neces-

sary driving-pulleys and counter-shafts. The necessary driving-power was contracted for by the Commission at the rate of $118.12 during the exhibition for each horse-power measured on the driving-shaft. It was the desire of the Commission that each nation should furnish the necessary engines and boilers for driving its own machinery, to be paid for at the same rate as was given to the French contractors, and this offer was accepted in several instances.

The price of any article exhibited, and the place of sale, could be affixed if the exhibitors so desired, and to insure the correct figures being given, it was provided that the exhibitor was obliged to sell the article at the price named, if any one wished to purchase, on pain of having it excluded from competition. It was made obligatory on all exhibitors in class 91 (*l'Exposition á bon marché*) to put prices on the articles.

Official reports and records.—While the Imperial Commission were careful, as has been shown, to devise complete arrangements for the management of this great display, they also took steps to have such a record made of its character and significance as would be of permanent benefit to the community.

In every department of France commissions were organized which were intrusted with the duties of communicating information in regard to the exhibition, endeavoring to secure exhibits specially representing their departments, as well as the best general articles produced, and they were made to understand that upon their exertions it mainly depended whether or not France should be properly represented at the exhibition. These department-commissions were also directed to open subscription-lists and raise money to send committees of foremen, artisans, and agriculturists to the exhibition, both for their own instruction and to prepare reports for the use of their fellow-townsmen, to procure special premiums, and to defray the expense of publishing these special reports They were further instructed to urge upon large manufacturers the propriety of sending a certain number of their workmen to examine and report upon the exhibition.

Other countries followed the example of France and sent over special delegations of artisans and agriculturists to make reports upon their observations.

The beneficial results of such action cannot well be overestimated but a still more important step was the organization of a Scientific Commission, appointed by the Imperial Commission or nominated by other governments. Many foreign governments also appointed their own Scientific Commissions, with directions to prepare reports.

Another means of wide-spread publication of useful and interesting information was afforded by the catalogue of the exhibits, which was freely circulated.

Each nation was requested to prepare a succinct statement for insertion in the official catalogue, which was printed in several languages,

in relation to the territory of their country, its population, productive force, commerce, interior transportation, maritime navigation, army, navy, finance, and special industrial institutions.

45. *Juries and awards.*—By the organization of a jury composed of the foremost scientific men and experts of the world, a series of reports was obtained that afford a valuable insight into the merits of this great exhibition.

The total number of jurors was six hundred, divided into one special jury, ninety-four class-juries, ten group-juries, and a superior council.

The special jury, composed of twenty-five members, examined the exhibits competing for a new order of awards, "intended for persons, establishments, or localities, which, by organization or special institutions, have developed harmony among co-operators, and produced in an eminent degree the material, moral, and intellectual well-being of the workmen."

Four class-juries were assigned to the five classes of Group I; and the awards of these juries were adjusted and finally decided by a group-jury, consisting of these four juries united. Each of the remaining ninety-four class-juries examined the articles of a special class, their work being afterward revised by the group-juries and by the superior council.

A group-jury was composed of the presidents and reporters of the class-juries in that group, together with a president and two vice-presidents specially appointed. Each group-jury revised the reports of the juries in that class, approving or disapproving the awards as seemed proper. The superior council was made up of the presidents and vice-presidents of the group-juries, with the addition of one of the vice-presidents of the Imperial Commission. This council determined the whole number of awards that should be made, and the number and grades that should be given to a group. Their decision was handed to the several group-juries, who distributed the awards among the articles in their group, their action being final.

In the general regulations, it was provided that there should be a definite number of prizes, which was stated, but the superior council was authorized to change this number to a limited extent, if it seemed desirable. The following is a list of the prizes as determined by regulation:

The prizes in Group I were 139 in number, valued at $19,417. They consisted of—

17 grand prizes, each valued at	$388 34
32 first prizes, each valued at	155 34
44 second prizes, each valued at	97 09
46 third prizes, each valued at	77 67

In the remaining nine groups, the prizes were 9,100 in number, valued at $4,964.25, viz:

100 gold medals, each valued at $194.17.

These were awarded for inventions or improvements in the quality of products or mode of manufacturing.

1,000 silver medals.

3,000 bronze medals.

5,000 honorable mentions.

The new order of awards consisted of 10 prizes, each of the value of $1,941.70, with the privilege of adding a grand prize of the value of $19,417 "to the person, establishment, or locality (of merit) above all the rest." These prizes were generally regarded as the most important that were awarded.

In the appointment of the jurors they were apportioned among the different nationalities, in accordance with the space occupied by each in the industrial palace. A list was made out stating the number assigned to each country, and foreign governments were invited to send lists of names, and to indicate the classes in which they would like their jurors to serve, although the imperial commission stated that it might be impossible to gratify them in this particular.

The jurors were required to finish their work between the 1st of April and the 14th of May, 1867, and the formal distribution of prizes was fixed for the 1st of July. The juries on classes 62, 67, 68, and 95 were excepted from this general regulation, being allowed to continue their work up to the end of the exhibition.

It was provided that exhibitors who were members of the International Jury should be excluded from competition, except those in Group I, the Imperial Commission reserving the privilege, however, of making other special exceptions, if it seemed desirable. Each jury was allowed to call in the aid of associates appointed by the Imperial Commission, to assist them in making examinations and tests.

A table in the report of N. M. Beckwith, United States Commissioner-General, shows the distribution of awards to the principal countries represented at the exposition. This table may be found on page 8 of the "General Survey of the Exhibition, Reports of the United States Commissioners,"* volume 1, which may be consulted for matters of detail.

This brief review of the great Exposition of 1867 shows how thoroughly the French government appreciated the advantages to be derived from exhibitions of this character, and affords many useful hints in regard to the principles that should govern the organization and details of arrangement.

THE VIENNA INTERNATIONAL EXHIBITION, 1873.

46. *Inception.*—In the year 1871 it was determined by the Austrian government to prepare for an international exhibition to be held at Vienna in 1873.

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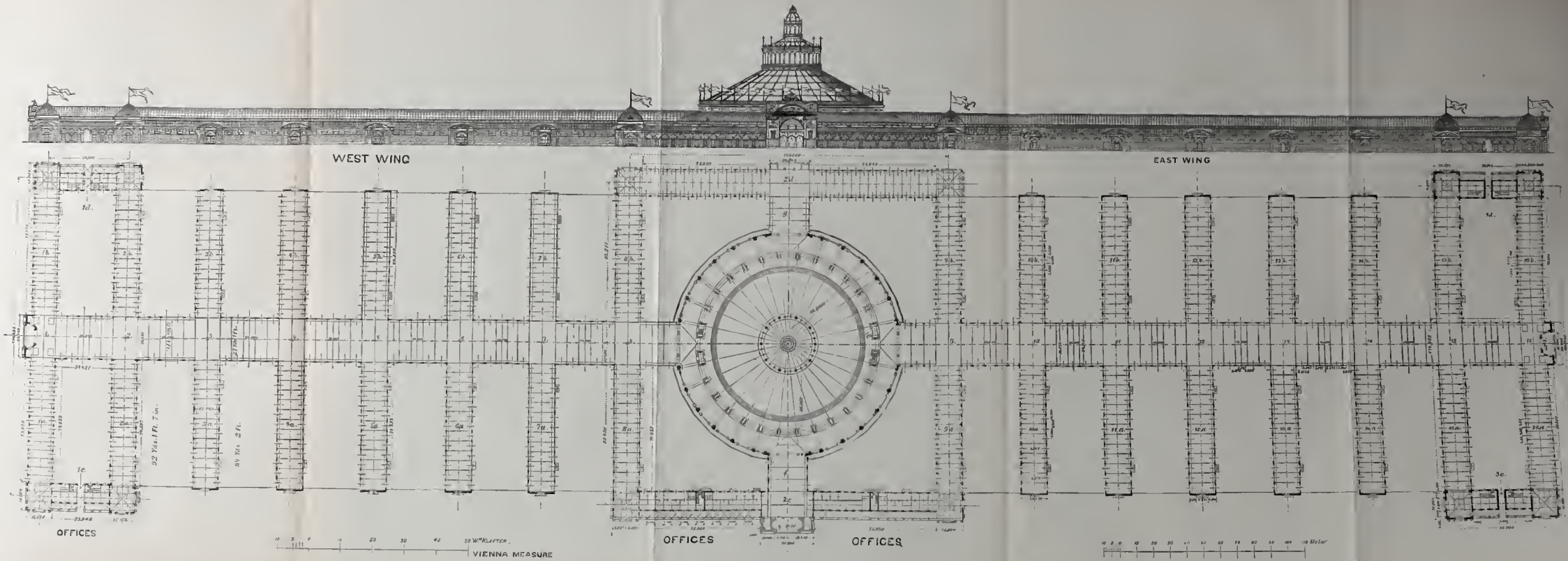
* Washington: Government Printing-Office. 1870.

LONGITUDINAL VIEW AND PLAN OF INDUSTRIAL PALACE.



VIENNA INTERNATIONAL EXHIBITION, 1873.

In accordance with this action of the ministry, the following programme was issued and circulated at home and abroad, and invitations were extended to foreign governments to co-operate with the Austrian in making the exhibition as complete as possible as a display of the industrial products of all nations.

PROGRAMME.

I. Under the august patronage of His Imperial and Royal Majesty the Emperor, an International Exhibition will be held at Vienna in the year 1873, having for its aim to represent the present state of modern civilization and the entire sphere of national economy, and to promote its further development and progress.

This Exhibition will take place in buildings specially erected for the purpose in the imperial park called the Prater; it will be opened on the 1st of May, 1873, and closed on the 31st of October of the same year.

II. The following is the classification adopted for the objects exhibited, separating them into twenty-six groups:

Group 1. Mining, quarrying, and metallurgy.
Group 2. Agriculture, horticulture, and forestry.
Group 3. Chemical industry.
Group 4. Articles of food as products of industry.
Group 5. Textile industry and clothing.
Group 6. Leather and India-rubber industry.
Group 7. Metal industry.
Group 8. Wood industry.
Group 9. Stone, earthenware, and glass industry.
Group 10. Small ware and fancy goods.
Group 11. Paper industry and stationery.
Group 12. Graphic arts and industrial drawing.
Group 13. Machinery and means of transport.
Group 14. Philosophical instruments, surgical instruments.
Group 15. Musical instruments.

Group 16. The art of war. This group includes all objects and contrivances belonging to the equipment of the army, and the relief of the sick and wounded.

Group 17. The navy. This group comprehends everything relating to the navigation on the sea, on lakes and rivers, ship-building, the fitting out of ships, the construction of harbors and light-houses, life-boats, and salvage.

Group 18. Civil engineering, public works and architecture. In this group will be exhibited the plans and models of executed or projected works belonging to roads and railways, aqueducts, irrigation, drainage, reservoirs, canal and river embankments, private dwellings and cottages, and public buildings (houses of parliament, theatres, hospitals, bathing-

establishments, public wash-houses, &c.) and also methods of lighting, ventilating, and warming.

Group 19. The private dwelling-house, its inner arrangement and decoration.

Group 20. The farm-house, its arrangements, furniture, and utensils. In these two groups it is expected that the different nations will exhibit their peculiar forms and actual conditions of domestic life.

Group 21. National domestic industry. This group is intended to make known the variety and abundance of valuable designs and forms, which the productions of national domestic industry, such as ornaments, potteries, textures, &c., contain.

Group 22. Representation of the influence of museums of fine arts applied to industry. The object of this department is to show the means by aid of which the modern museums of fine arts applied to industry (viz, the South Kensington Museum in London, and the similar museums in Vienna, Berlin, Moscow, &c.) endeavor to improve the public taste and diffuse artistic education.

Group 23. Art applied to religion. This group will contain all the products of industry and the works of fine arts which are employed in public worship.

Group 24. Objects of fine arts of the past, exhibited by amateurs and owners of collections. (*Exposition des amateurs.*) This group has as its aim to enable the visitor to see an exhibition of treasures of private collections of works of fine arts, which are usually accessible only to a limited few, thus giving students and others engaged in artistic pursuits an opportunity to gain new ideas.

Group 25. Fine arts of the present time. This group will contain works of fine arts produced since the International Exhibition of London in 1862.

Group 26. Education, teaching, and instruction. This group will contain: (*a*) A representation of the objects and inventions which can assist in the education of a child and contribute to its physical, intellectual, and moral development from its birth to the time of its entering school; (*b*) Educational and school matters, from the elementary school upward to the technical school and the university; (*c*) The entire system of instruction and culture, so far as it can be brought into view by products of literature, of the public press, societies, public libraries, graphic, and statistical records.

III. There will be competitive trials of machinery, apparatus, processes, and methods of work of different dates, showing their successive improvements; for example: Sewing-machines, weaving machines, telegraphy, photography, &c.; an attempt will thus be made to give an epitome of the history of inventions. In addition to this, an attempt will be made to place side by side the productions of machines and handwork to show how in some cases machines have superseded handwork, while in others they have aided and increased its products.

IV. By exhibiting also analogous products of industry, manufactured at different epochs, with their relative prices and with samples and models, it is intended to show the increasing power of different industries, their dependence on the changes in taste and their influence upon taste, as well as their importance in national economy at different epochs, thus exhibiting the history of industry.

V. To show by a retrospective view the influence of science on the progress and development of manufactures, there will be exhibited the gradual conversion of waste into use, or the increase in the employment of the former, by comparing the waste with the articles manufactured therefrom, and also the intermediate products, so far as these are the result of inventions and discoveries since the first International Exhibition of London in 1851.

VI. A further aim in this Exhibition is to give the history of prices; to exhibit from the chief districts of production the prices of more important articles, going as far back as possible and placed side by side in average periods of five years and illustrated by samples and specimens.

VII. To show the international exchange of products, a representation of the commerce and trade of the world will be formed. For this purpose samples and specimens of the articles of trade and commerce of all the important harbors and seaports are to be exhibited.

On each sample will be marked its origin, its destination, its price and value, the quantity of import and export, &c.; along with these will be shown statistical and graphic tables, the movement of the navigation and commerce of each seaport during the last ten years.

VIII. The intention just expressed of aiding the study of this Exhibition by the help of statistical and graphical tables, will be carried into effect in all the departments of the Exhibition, by showing, from official records, the industrial progress made by each country since the first International Exhibition of London in 1851. For example: there will be exhibited tables of the increasing areas of cultivated soil, the annual quantities of agricultural products, the value of the land, the interest on money, the traffic and capital of railways, the increase of population, &c., as they have appeared at each of the periods of subsequent international exhibitions, viz, Paris, 1855, London, 1862, Paris, 1867.

Thus there will be shown the productive powers of different nations in the respective departments assigned to their products in the Exhibition-building.

On the other hand all particulars of the different articles to be exhibited, such as the name of the exhibitor, the description of the objects, the price (which the exhibitor is at liberty to attach if he please) may be shown on labels attached to each article.

In the same manner all other information of public interest, the exhibitor may wish to have published, such as the history and importance

of the establishment, its progressive development, its annual production, may also be written or printed and annexed to the objects exhibited; in contradistinction to former international exhibitions which confined these informations to the printed catalogue.

IX. For the purpose of rendering this Exhibition especially instructive and educational, it is intended to make comparative trials and experiments on processes new or hitherto little known. The value of objects exhibited will be submitted to practical tests. For example: Experiments will be made regarding the production of wines, (application of the hydro-extractor, heating of wines, &c.,) trials with machine-tools of every description, application of the electric light, utilizing of aërostation, (captive balloons, &c.,) experiments with explosive materials, with steam ploughs, transmission of power by wire ropes, locomotives, engines on common roads, steam fire-engines, &c.

Lectures will be given on these subjects in a special lecture-room of the Exhibition, and international prize-problems issued, as, for example, on the best implements for the cultivation of beet-roots for the fabrication of sugar.

X. Arrangements will be made for a series of temporary international exhibitions of such articles as, by their nature, do not admit of an exposition of long duration. They will comprise: Living animals, (horses, cattle, sheep, pigs, dogs, cats, fowls, game, fish, &c.;) poultry, venison, butcher's meat, lard, &c.; dairy produce; milk, cheese, &c.; vegetable produce; fresh fruits, fresh vegetables, flowers, plants, &c.; living plants injurious to agriculture and forestry.

Dynamometric experiments will be made on the tractive force of animals. Also international races, at the time of the Exhibition, of thoroughbred horses will take place, and for these races prizes will be awarded.

Representations of all other kinds of sports, (regattas, &c.,) and also national games and plays will be arranged.

Some of these temporary exhibitions will give rise to practical experiments and practical discussions on the matters to which they refer. For example, the exhibition of dairy produce will give rise to a series of experiments on the improvements relative to the manufacturing of butter and cheese, &c.

To enable the public to appreciate alimentary substances exhibited, refreshment-rooms (tasting pavilions) will be erected, where each exhibitor can sell samples of his products even in the shape of cooked food.

XI. During the Exhibition, various international congresses and conferences will be arranged for discussing important matters, to which the Exhibition itself may give rise, or those specially selected as subjects of international discussion. More especially there will be international congresses of men of science, teachers and artists, physicians, directors of museums of fine art applied to industry, teachers of draw-

ing, architects, engineers, representatives of chambers of commerce, economists acquainted with the questions relative to banking and insurance, of agriculturists, foresters, mining-engineers, &c. Among questions subject to such discussion will be the following: The question of intellectual property, of the improvement of public taste, of the promotion and diffusion of arts of design; on economy of transport, on obtaining the highest efficiency of machines, on the extension and development of forest statics, on reducing the price of food, whether by increased production, better organization of markets, reformed cookery, or new methods of preserving food; on the nourishment and early rearing of an infant, on early healthful training and gymnastics, on the exertions of our time in regard to the curing of deformed children, on the education of woman and improvement of her social condition.

XII. The division of space allotted to each foreign commission will be geographical, that is to say, according to countries, in such a manner that the different territories of production will appear as nearly as possible in the same order as they are situated naturally in the direction from west to east.

XIII. With reference to such objects as admit of a classification in several of the groups specified in paragraph II, it is left at the option of the exhibitor to name the particular group in which he wishes his articles to be placed.

XIV. An International Jury will be appointed to award the prizes. Each exhibitor must declare whether he wishes to submit to the judgment of the jury or not. In the latter case, the object exhibited will be ticketed "*Hors concours*," (no competitor.) The awards granted by the jury will be as follows:

A. For the fine arts the prize will be given in the form of a medal for fine arts.

B. For the other objects exhibited the prizes will be as follows:

(*a*) Exhibitors in former universal exhibitions will receive, for the progress they have made since the last exhibition, a medal for progress.

(*b*) Exhibitors for the first time taking part in a universal exhibition will receive, as a reward for the merit they have shown in a nationnal, economical, or technical point of view, the medal for merit.

(*c*) Exhibitors whose productions fulfil all the conditions of refined taste in color or in form, will have the medal for taste.

(*d*) There will also be given diplomas of merit, similar to the honorable mentions of former universal exhibitions.

C. The assistants and workmen who, according to the statements made by the exhibitors, have taken a notable part in the production of a rewarded object, shall have the medal for co-operation.

D. The merits of individuals or corporations who have promoted the education of the people, the development of industry or the national economy, or have specially promoted the intellectual, moral, and material welfare of the working-classes, shall be rewarded by special diplomas of honor.

XV. The detailed arrangements for the organization of the Exhibition, the composition and operations of the juries, the system of the catalogues, reports, &c., will be the object of general and special rules.

42 Praterstrasse, September 16, 1871. Vienna.

The President of the Imperial Commission,

ARCHDUKE REGNIER.

The Chief Manager,

BARON DE SCHWARZ-SENBORN.

47. *Location.*—The location of the Exhibition buildings in the Prater, the great public park of Vienna, combined the advantages of a site within a walk of thirty minutes of the center of the city, and a ready means of connection with all the railways entering the metropolis.

The Prater (Plate I) is a beautiful park, of vast extent, and has long been the favorite resort of all classes of the population of Vienna. A better location could hardly have been desired. Especially in the matter of railway connections were the inconveniences previously experienced at London and Paris obviated, since, by means of an admirable system of branch-tracks and sidings, building-material and articles for exhibition were conveyed nearly, or exactly, to the places where wanted.

Vienna is the "Kaiserstadt," or imperial city, of the Austrian dominions, and contains a population of about 620,000 inhabitants. It derives its name from the Wien, a small stream tributary to that branch of the Danube nearest which the city is located. The suburbs cover a considerably larger area than the city, and are well paved and lighted.

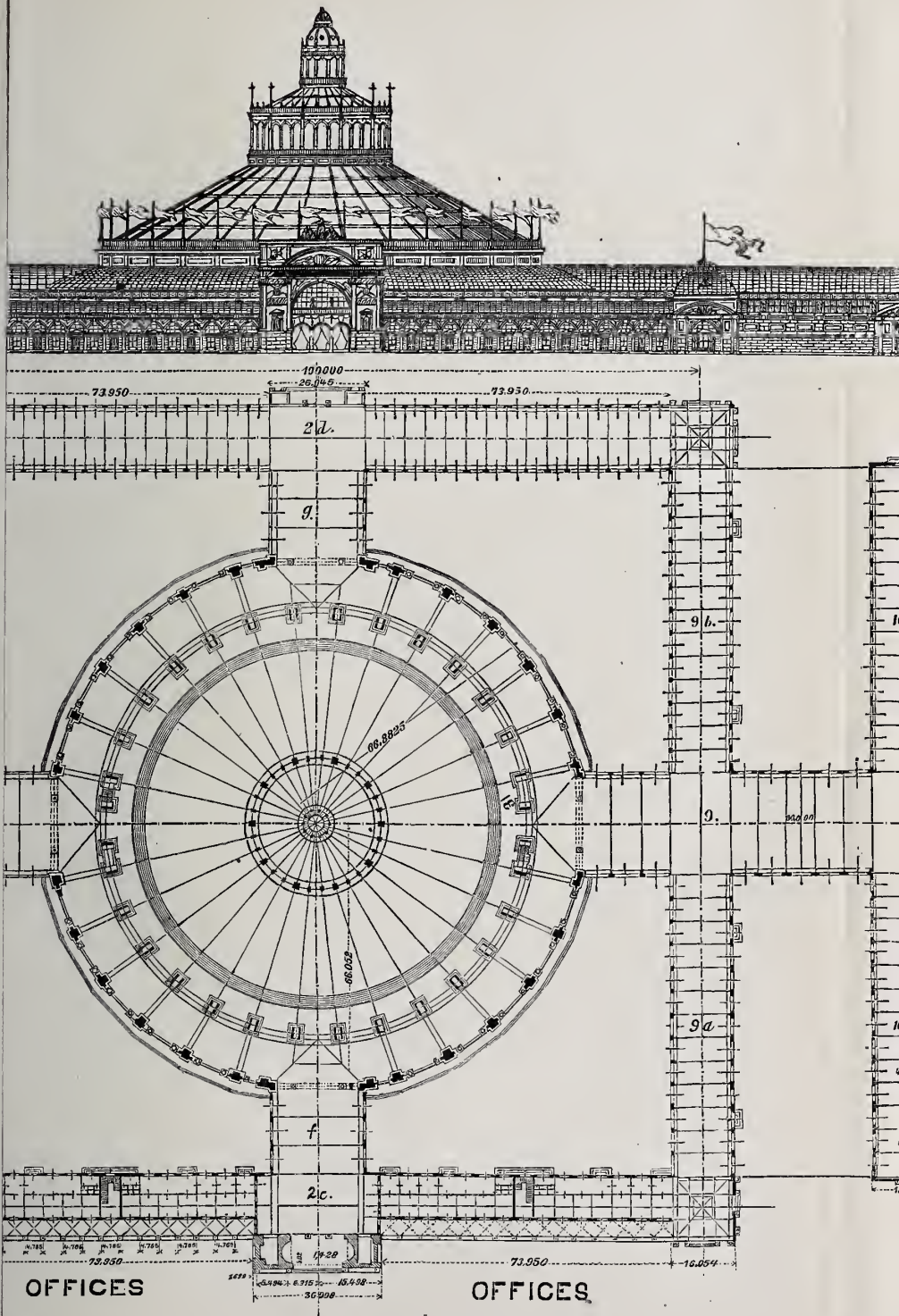
48. *Arrangement.*—In originating the general plan of the Vienna Exhibition, it was determined to construct an Industrial Palace for the display of the principal collection of exhibits, and to provide separate buildings for the departments of machinery and fine arts, respectively. Experience had shown, in earlier exhibitions, that the smell of hot oil and the noise and motion of machinery are unpleasant to the mass of visitors inspecting other objects of interest, and that owners of choice works of art hesitate to exhibit them, unless especial precautions are taken against risks of fire and other causes of injury or loss. These considerations led to the adoption of three groups of buildings.

When the applications for space came to the consideration of the Imperial Commission, it was found that the Industrial Palace and Machinery Hall were inadequate to meet the demands made upon their capacity, and, as a measure of relief, it was determined to erect two annexes, one to contain the agricultural tools of Germany, Austria, and Russia, and the other those of England, France, Italy, and America.

The original purpose of locating the restaurants in the Industrial Palace was also abandoned, and provision was made for them in separate buildings scattered about the park.

The lack of space in the main building was further compensated by allowing those countries which had been assigned space in the tran-

VIEW AND PLAN OF INDUSTRIAL PALA



VIENNA INTERNATIONAL EXHIBITION, 1873.

septs to occupy also the adjoining garden courts, and to roof them over where required; and also by permitting countries making large displays to erect separate buildings in the park at their own expense.

The original design for the Art Gallery was expanded by the addition of two annexes to serve as exhibition-rooms for loan-collections. Separate buildings were also erected for the various offices, as well as an Imperial Pavilion, which was fitted up by the principal decorators and upholsterers of Vienna in the most lavish manner.

An abundant supply of water was obtained from wells, and raised by pumps to a distributing-reservoir supported upon a tower. The "Holly system" of pumping directly into the pipes was also employed in supplying some of the fountains. Fire-hydrants were numerously located in the buildings and about the park, and an efficient fire department was held in constant readiness to act.

49. *Buildings.*—The Industrial Palace (Plate II) consisted of a central nave, 2,953 feet long, 83 feet 8 inches wide, and 73 feet 10 inches high, of sixteen intersecting transepts, each 572 feet 6 inches long, 51 feet 1 inch wide, and 41 feet high, and of a great rotunda of 354 feet diameter, and the largest in the world, at the middle of the nave.

The nave where it met the rotunda, divided, and formed a circular aisle about it. The great central transept intersecting the middle of this aisle was of the same height and width as the nave.

The two transepts upon each end of the Industrial Palace were connected by façades, thus forming inclosed garden courts. The other courts were open at one end, except that the rotunda was inclosed in a quadrangle 675 feet 10 inches square, intended with the dome to remain a permanent monument of the great exhibition.

The "gridiron form" of plan for the Industrial Palace was adopted, in order to bring the side windows sufficiently near to the interior of the building to obviate the necessity of employing a glass roof, with its inevitable tendency to leak during rain-storms, and to admit too much light in bright weather. The same arrangement also rendered it easy for visitors to learn their location at any time, and to find their way in direct lines from one country to another, since the axes of the transepts were located nearly north and south, and that of the nave consequently nearly east and west, and the countries were placed as nearly as possible to correspond with the positions which they occupy upon a mercatorial projection of the world. An elementary knowledge of geography thus enabled the visitor readily to find his way about.

The rotunda was added with a view to architectural effect, and to provide a spacious hall for ceremonies and festivities. The straggling appearance of the building was further corrected by uniting the central and end transepts, respectively, by buildings parallel to the nave, as has been already described. Mr. Charles Hasenauer was the chief architect of the exhibition. The rotunda was constructed from designs furnished by Mr. John Scott Russell.

The superstructure of the Industrial Palace was supported upon piles capped with timber. It was originally intended to support the roof-trusses upon wooden columns, and to fill the intermediate panels with brick-work. The roof-trusses were also to have been composed of wood. This plan, however, owing to a conspiracy said to have been formed by the Austrian contractors to raise the price of wood, was so far departed from that iron columns and roof-trusses were substituted.

Wooden purlins and a light covering of boards were used, the covering consisting of zinc plates. The brick panels were plastered within and without. The wing aisle being intended to form part of a permanent structure, was built of solid brick piers and arches. The roof-trusses were iron-plate girders.

The rotunda consisted essentially of a cylinder 80 feet in height and 354 feet in diameter, surmounted by a conical roof inclined at an angle of 30° 45′.

This cone was truncated at the point where its horizontal diameter was 100 feet, to form the base ring of a cylindrical lantern also 100 feet in diameter, which rose to a height of 30 feet, and was covered with a conical roof, inclined at the same angle as the first. The lantern was surmounted by a dome, on the summit of which rested the imperial crown of Austria.

The main cone rested upon a massive wrought-iron ring, supported in turn by thirty-two wrought-iron pillars. This ring resisted the horizontal thrust of the dome. A similar ring, differing somewhat in form, was employed at the base of the lantern. The skin of the cone was composed of riveted plates, which were one-half inch thick at the base and diminished toward the crown; and, as this alone would have proved insufficiently stiff under all conditions of unequal loading, a stiffening structure was added. This consisted of radial girders of diminishing depth, extending from the head of the pillars to the imaginary apex of the cone, and concentric ring-girders, normal to the surface of the cone.

The details of the lantern, and upper cone, are quite similar to those of the principal cone and cylinder of pillars which they surmount.

Brackets at the head of the pillars supported a gallery reaching entirely around the dome, a distance of about 1,050 feet. The floor of the rotunda was reached by a descent of several steps running all around.

The Industrial Palace was floored with 6-inch boards, laid in the directions of the nave and transepts, and with considerable interstices, to allow sweepings to fall between them.

Decoration was confined principally to the walls of the building, the roof-trusses being simply painted olive-green, and the boarding behind them whitewashed to give a light effect. Wooden pillars were placed in front of the iron lattice columns, already described, upon which the roof-trusses were supported, and being furnished with wooden pedestals and moldings and plaster of Paris capitals, all painted to resemble

bronze, were covered with tightly strained canvas, adorned with spiral lines of gold. These pillars carried handsome wooden cornices, painted of a creamy-gray color, picked out with gold.

The lower portion of the walls, principally occupied by show-cases, was painted in panels of light neutral green. The upper portions were covered with canvas printed with arabesque patterns, in dark blue and orange, by a process invented by Senor Bossi, of Milan. The effect was that of the most carefully-executed painting.

The several entrances and vestibules, and the screens between the nave and ring aisle, were handsomely decorated in stucco. The ventilation of the Industrial Palace left little to be desired. The numerous windows, opening near the roof, conduced largely to produce air-currents, while the rotunda acted like a great ventilating-chimney, from which the air supplied from the nave and transepts, becoming heated, escaped through the lantern with great regularity.

The Machinery Hall, situated upon the north side of the Industrial Palace, at a distance of about 500 feet from the latter, consisted of a continuous rectangular building 2,625 feet long, and 164 feet wide. The building was divided into a nave and two side aisles, separated by brick piers and flat arches, springing from the middle of their height. The spaces above the arches were occupied by windows. The outer walls of the aisles consisted of similar smaller piers, between which windows were placed.

The nave occupied a width of 96 feet 9 inches, and was spanned by triangular roof-trusses of iron, rafters with a single pitch being employed in each side-aisle. Wooden purlins, with a covering of light boards and zinc plates, comprised the roof.

The boilers were located in pits covered with roofs outside of the main building, each country exhibiting machinery in motion having its own boiler-house.

The floor of the Machinery Hall consisted of joists bedded in gravel and covered with plank, that in the nave being 2.6 inches thick, and that in the aisles 1.4 inches. There were two lines of shafting carried upon a substantial iron framework in the center of the nave.

The Machinery Hall, with its long, straight lines unrelieved by embellishments or considerable projections of any kind, could hardly lay claim to pleasing architectural effect, although this was of the less consequence, as there were few points from which the eye could command a view of its whole length, while the interior presented a remarkable vista of piers and trusses.

There were several small wooden buildings, not yet mentioned, which were generally of a rather rough character, adjoining the Machinery Hall, principally containing agricultural implements.

The frontispiece represents a general view, and Plate III a plan, of all the Exhibition buildings. The various covered ways seen in the general view, and which have been previously mentioned, consisted of

light wooden frames, 18 feet 8 inches wide, roofed over but open at the sides. The legend accompanying the plan indicates the arrangement and disposition and the purposes for which all buildings were designed.

The lighting was excellent, both side-windows and sky-lights being employed.

The area occupied by the Industrial Palace was approximately as follows:

Building proper	918,000 square feet.
Closed courts	258,500 square feet.
Open courts	656,500 square feet.
Total	1,833,000 square feet.

The Machinery Hall covered an area of approximately 429,000 square feet.*

KEY TO GROUND PLAN.

BUILDINGS IN THE EXHIBITION GROUNDS, PLATE III.

Behind the Machinery Hall.

1. Bakery of Carl Heillinger.
2. Machine building.
3. Waiting-rooms.
4. American boiler-house.
5. English workmen's dwellings.
6. English boiler-house.
7. English gas-factory.
8. Pavilion of Belgian commission.
9. French boiler-house.
10. Machinery workshops.
11. Swiss boiler-house.
12. Cloak-rooms.
13. Belgian boiler-house.
14. Pavilion of the trade of the world.
15. German boiler-house.
16. German Empire pavilion, (pavilion for brickmaking and ice-factory.)
17. Waiting-rooms.
18. Austrian boiler-house.
19. Northern Railway pavilion.
20. Northwestern Railway pavilion.
21. Machinery building.
22. Pavilions of Mr. Ringhoffer, of Prague.

On the other side of the Heustadl Waters.

1. Entrance.
2. Kriau, (Sacher's restaurant.)
3. Collective exhibition of the Styrian proprietors of forests.
4. Shareholder's company for forest industry.

4*a*. Shareholder's company "Agricola" farming.

5. Russian peasant's hut.
6. Machinery building.
7. Swedish peasant's hut.
8. Pavilion of Hungarian forest produce.
9. Cracow peasant's hut.
10. Von Ganahl's farm-house in Feldkirchen.
11. Hungarian peasants' huts:
    - *a*. Hungarian.
    - *b*. Saxon.
    - *c*. Geydelerhouse.
    - *d*. Roumanian.
    - *e*. Geydelerhouse.
    - *f*. Soldiers' houses of the military frontier.
12. Baron Pittel's stable.
13. Cloak-room.
14. Borkowsky, laborer's cottage.
15. Chevaler de Mlodecky's farm-house.
16. Walne, and Alpine hut.
17. Farm of the Agricultural Society of Vienna.
18. Horse and cattle show.
19. Vienna Photographers' Association.
20. Military building-yard.
21. Military barracks.

Between the Machinery Hall and the Industrial Hall.

1. Western entrance.
2. American restaurant.

*For more detailed information consult the Reports on Architecture, which contain important illustrations.

3. Court bakery of Roman Uhl.
4. Cook's Tourist's pavilion.
5. Seed pavilion.
6. Watertower.
7. English commissioner's house.
8. Western agricultural hall, (including Great Britain.)
9. Cloak-room.
10. Swedish restaurant, (Café Blanche.)
11. Norwegian fishery.
12. Lapland hut, (Laplatta.)
13. Swedish fishery.
14. Norwegian garden pavilion, (Jacoben & Haueburg.)
15. German school-house.
16. German Empire, (mining industry.)
17. Dreher's beer-tasting hall.
18. The Duke of Saxe-Cobourg-Gotha's pavilion.
19. Prince J. Adolphus Schwarzenberg's pavilion.
20. Pavilion Mauthner, (Son.)
21. Jacob Mung & Company, (pavilion.)
22. Waagner's stable.
23. Curti, (cement obelisk.)
23*a*. Chailly house of artificial stone.
24. Industrial Society of Prague, formerly Danck.
25. Vordernberg-Koflach Mining Industry Company.
26. Board of the Iunerburg Shareholders' Company, (mining industry.)
27. Shareholder's brewery, Silberech,(bar.)
28. Corinthian Mining Industry Society, (Huttenberger.)
29. Mr. Bosch's pavilion.
30. Vincent Wenzel's pavilion for fire-proof roofing.
31. Pavilion, Steffen's, (machine.)
32. Witkowitz railway bridge.
33. Baron de Rothschild's pavilion.
33*a*. Lederer & Nesenyi.
34. English restaurant.
35. Pavilion of the Shareholders' Company for the construction of bridges and roads.
36. John Schubert's pavilion.
37. Steinor, Tyrolese cottage.
38. Imperial and Royal State Railway.
39. Pavilion for the representation of the history of invention in women's work.
40. Agricultural ministry.
41. Cloak-room.
42. Alsatian farm-house.
43. Danubian Steam Navigation Company.
44. Wine-testing hall.
45. Eastern Agricultural Hall.
46. Cloak-room.

Before the Industrial Palace.

1. American restaurant of Mr. Kune.
2. Private brewery of Pilsen.
3. Shareholders' brewery of Pilsen.
4. Hungarian shepherd's cottage.
5. American Kiosk.
6. New Free Press.
7. Liesing beer-saloon.
8. Rosshard's Swiss bar.
9. Swiss music-hall.
10. Cloak-room.
11. Boiler-house.
12. French restaurant.
13. Soda-water pavilion.
14. Prince of Monaco's pavilion.
15. Swedish hunting-box.
16. Swedish army exhibition.
17. Swedish school-house.
18. Pavilion of the domain Finspong.
19. Mining products.
20. Monument of Wasserburger.
21. Martin Kien, portable dwelling-house.
22. Kiosk of the Southern Railway.
23. Chevalier de Stark's pavilion.
24. Pavilion of the savings-bank.
25. Infants' pavilion.
26. Pavilion for metal industry.
27. Austrian medicinal springs.
28. Trade in specialties.
29. Russian pavilion of Mr. Sidorof.
30. Russian pavilion of M. Reimers.
31. Russian dwelling-house.
32. Russian restaurant of Mr. Engel.
33. Charles Hochstetter—products of the Perlmoser Cement Manufactory, limited.
34. Waiting-rooms.
35. French restaurant of M. Goyard.
36. Italian restaurant.
37. Italian wine-saloon.
38. Styrian wine-saloon.
39. American tent, (Bech and Dommat.)
40. Music hall.
41. Austrian Lloyd's.
42. Egyptian buildings.
43. Waagner glass-house.
44, Oriental club-house of Dr. Hardt.
45. Light-house of the maritime board.
46. Turkish buildings.
47. Persian villa.
48. Restaurant of Mr. Arrnstein, of Trieste.

Space in square meters allotted to each country in the Industrial, Machinery, and Agricultural Halls.

	Industrial all	Adjoining courts.		Machinery Hall.	Agricultural Hall.
		Covered.	Open.		
Austria	14,767			11,000	
Germany	6,714			10,000	
France	6,308			5,580	2,500
England	6,369			5,305	4,500
Russia	3,319			1,250	
Hungary	2,972			350	
Italy	2,972			950	950
Turkey	2,938				
Belgium	2,613			3,000	356
China, Siam, and Japan	1,350				
United States of America	1,358			1,250	115
Switzerland	1,125			3,049	475
South America	1,090				
Egypt and mid-Africa	1,003				
Holland	880			240	
Greece	867				
Sweden and Norway	865			280	260
Roumania	657				
Spain	605				640
Portugal	519				350
Persia and mid-Asia	346				
Tunis	259				
Morocco	86				
Denmark				300	170

50. *General regulations* for the foreign exhibitors and commissions were issued as follows:

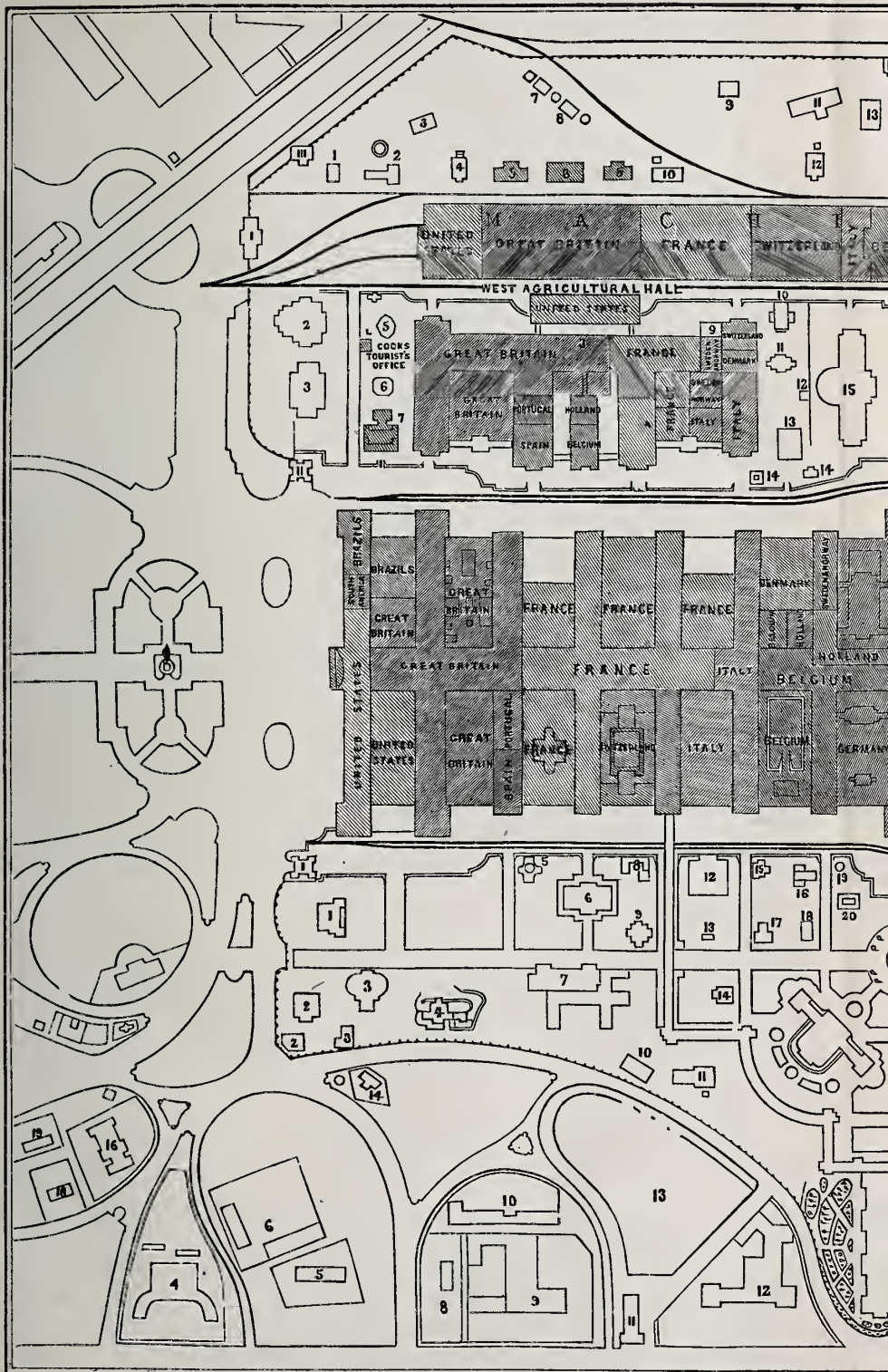
I.—General directions.

(1.) Under the patronage of His Most Gracious Imperial and Royal Apostolic Majesty, and under the protectorate of His Imperial Highness the Archduke Charles Lewis, the Exhibition will take place in the Prater in buildings erected specially for the purpose, and in the surrounding park and gardens. It will be opened on the 1st of May, 1873, and closed on the 31st of October of the same year.

(2.) Under the presidency of His Imperial Highness the Archduke Régnier, an Imperial Commission has been formed, for the purpose of representation and of discussing all general questions concerning the Exhibition.

(3.) His Majesty has intrusted the direction of the Exhibition to the Privy Councillor Baron de Schwarz-Senborn, as Chief Manager.

(4.) Foreign governments are invited to appoint commissions, with whom the Chief Manager will stand in direct communication, upon all affairs concerning the Exhibition. These commissions will have to represent the interests of their countrymen in all questions relating to the Exhibition, and do their best duly to carry out its programme. Their task will be more particularly to issue invitations to take part in the Exhibition, to receive applications for space, to decide on the admission of objects announced, and to take charge of the forwarding, exhibiting, and returning of the objects of the Exhibition in accordance with the regulations laid down.


WEST AGRICULTURAL HALL
UNITED STATES
GREAT BRITAIN
FRANCE
COOKS TOURIST'S OFFICE
PORTUGAL
HOLLAND
SPAIN
BELGIUM
ITALY
BRAZILS
GERMANY
DENMARK
SWITZERLAND

(5.) All communications from foreign commissions, concerning the Exhibition, should be addressed: An den k. k. General-Director der Weltausstellung 1873 in Wien; (translation: To the Chief Manager of the Universal Exhibition, 1873, in Vienna, Austria.)

(6.) A plan of the projected Exhibition-buildings and adjoining parks, showing the space allotted to each country, will be placed at the disposal of the commissions before the 15th February, 1872.

The commissions are invited to inform the Chief Manager before the 1st of May, 1872, whether their countrymen will occupy a larger or smaller space in the buildings; and also, whether they wish to have a part of the park adjoining their portion of the building.

(7.) The definitive division of space in the Exhibition-buildings, park, and gardens, resolved upon by the Chief Manager, will be made known to the commissions by the 1st July, 1872.

A plan showing the subdivision of the Exhibition (groups) must be sent, by the foreign commissions, to the Chief Manager at the latest by 1st October, 1872.

Lists of the exhibitors, as well as detailed plans, showing the space allotted, and each single object to be exhibited, must be sent in by oreign commissions before the 1st of January, 1873, at the latest, so hat the exigencies of the respective countries may be taken into account in organizing the interior arrangement of the Exhibition-buildings.

(8.) The exhibitors will not have to pay the expenses of a boarded floor, or of a closed ceiling, or contribute to the laying out of the adjoining gardens.

All these expenses will be paid out of the Exhibition-fund; but in return a total sum will be paid by each foreign nation, for the whole cubic space allotted to it in the Industrial Palace and the Machinery Hall, with a given fixed ground-floor, and calculated by the square meter, according to the following tariff:

	Austrian currency.
(*a*) In the Industrial Palace	fl. 10
(*b*) In the Machinery Hall	4

In the other parts of the Exhibition and adjoining grounds, the charges for hired space will be calculated by square meter, according to the following tariff:

	Austrian currency.
(*a*) In the court-yards of the Industrial Palace	fl. 4
(*b*) In the park:	
In the open air	1
In the spaces to be covered at the expense of the exhibitor	3

Exhibitors of objects of fine art and of those for the "*exposition des amateurs*" have no charge whatever to pay for space.

(9.) The Chief Manager will enter into communication with the railway

and steamboat companies of Austria and Hungary, in order to procure reductions of rates for the conveyance of objects for the Exhibition.

The foreign commissions are also invited to enter into communication with the railway and steamboat companies of their countries for the same purpose, and to communicate by the 1st of May, 1872, to the Chief Manager, the reductions which they have obtained.

The Chief Manager will then publish all the dates concerning these reductions by the 1st July, 1872.

(10.) The Exhibition-grounds will be considered as a bonded warehouse, and objects which are monopolies in Austria may also be exhibited without any hinderance.

(11.) Objects exhibited can only be removed before the closing of the Exhibition by special permission of the Chief Manager.

(12.) Immediately after the close of the Exhibition, the exhibitors must attend to the packing and removal of their goods and fittings.

These operations must be finished by the 31st of December, 1873.

The goods, packages and erections which may not have been removed by the exhibitors or their representatives after this term has expired will be deposited, if they are of sufficient value, in warehouses, at the cost and risk of the exhibitors.

The objects which may not have been removed out of these warehouses by the 30th June, 1874, will be sold publicly; the net proceeds of the sale will be employed in augmenting the collections of an institute for promoting the instruction of small trades-people and of workmen in Vienna.

(13.) The objects exhibited will be submitted to the judgment of an international jury, for which special regulations will be published.

(14.) An official general catalogue will be published, the arrangement of which will be made known later on.

In order that this catalogue may be published in time, the foreign commissions are requested to send the necessary dates at the latest on the 1st January, 1873.

(15.) A special locality will be provided in the Exhibition-grounds, where exhibitors can sell publications relating to the Exhibition and to the objects which they exhibit, (such as illustrated catalogues, current prices, &c.)

(16.) Popular lectures, and industrial, technical, or scientific demonstrations, will be arranged in a special lecture-hall built for that purpose. Nevertheless, the Chief Manager must be informed of the lectures.

(17.) Special regulations and programmes will be published for the works of fine art, for the exhibition of machinery, for additional and temporary exhibitions, for single groups and special dispositions, as tasting-pavilions, cellars, &c.

(18.) Each exhibitor is engaged to acknowledge and keep the regulations.

II.—Admission and classification of goods.

(19.) Concerning the admission of goods to be exhibited, the following are the limitations fixed: Explosive and detonating substances, and substances which may be considered inflammable, are entirely excluded.

Spirits or alcohols, oils, corrosive salts, highly inflammable and other matters, which might spoil other objects exhibited, or annoy the public, will only be admitted in strong, moderate-sized barrels, adapted for this purpose. Also the exhibitors of such objects will always be bound to conform themselves to any particular regulation the Chief Manager may think proper to make.

Percussion-caps, materials for fire-works, lucifer matches, and other similar objects, may only be exhibited in imitation, without the addition of inflammable substances.

(20.) Moreover, the Chief Manager reserves to himself the right to remove all goods from the Exhibition buildings which may seem injurious, by their quantity or nature, or which may appear incompatible with the purpose and regulations of the Exhibition.

(21.) The consignment of each single exhibitor must be accompanied by a certificate of admission issued by the commission of his country.

The detailed directions concerning the contents and form of this certificate will be communicated to the commissions by the Chief Manager.

III.—Forwarding, receiving, and erecting objects.

(22.) The exhibitor or the commissions have to defray all the expenses for the transport of objects to be exhibited, for the reception and opening of packages, for unpacking the objects, for removing and storing the empty cases, for making tables, counters, steps, boxes, for setting up the goods (products) in the Exhibition buildings or in the park, for returning the goods, (products,) &c.

(23.) The objects to be exhibited will be admitted from the 1st February until the 15th April, 1873, inclusive.

This period may be changed by the Chief Manager, at a special request, in consideration of particular circumstances, as for instance, for objects which would be damaged by remaining too long packed up, or for objects of great value; but in each case everything must be prepared in advance for the exhibition of objects.

(24.) Special regulations will fix the time when the materials must be brought into the Exhibition grounds,for constructions which form objects of the Exhibition, or disconnected apparatus or engines, heavy or very large objects, as well as those requiring special foundations.

(25.) All preparations for the exhibition of objects may be made in proportion to the completion of the buildings; but they must all be finished at the latest by the 15th of February, 1873.

(26.) The commissions are invited to take care that the products of their country be sent to Vienna in as few single consignments as possible.

(27.) All goods intended for the Exhibition are to be marked W. A., 1873, Vienna, and addressed to the Chief Manager.

The address must be securely fastened on the packages, and contain, besides, the following particulars:

(*a*) Name or firm of the exhibitor;
(*b*) Country and place of residence of the same;
(*c*) The group to which the objects belong;
(*d*) Number of application;
(*e*) A specification of the number of pieces of each single consignment; if the exhibitor has only sent one package, it will be marked No. 1, but if the same exhibitor has several packages to exhibit, their number must be marked on each package by a fraction; for instance, $\frac{1}{6}$, $\frac{2}{6}$, and so on. The figure 6 means that 6 pieces have been sent, of which the one is No. 1, the other is No. 2, &c. The persons appointed to receive the objects, will thus be enabled to know immediately after the arrival of the goods whether a consignment is complete, or whether a package is missing, and which number it is. If several small packages be packed in one large box, only objects belonging to the same group must be put into this box, which must then be marked as mentioned above.

The cases must bear the same mark inside, on the top and bottom, in order to prevent mistakes being made with the shifting of the different parts of the cases.

(*f*) The place where the objects are to be exhibited, *i. e.*, Industrial Palace, Park, or Machinery Hall.

The addresses will be of different colors, in order that the goods may be recognized the more easily, and the Chief Manager will communicate in time to the appointed foreign commissions the color of the address of the packages of their country.

Form of address:

W. A. 1873, Wien.

An den k. k. General-Director der Weltausstellung 1873. Wien.

Ausstellungsort:
(z. B. Industrie-Palace, Park oder Maschinenhalle.)

Namen oder Firma des Ausstellers.
Land und Wohnort.
Gruppe.
Ordnungszahl der Anmeldung.
Bruchzahl des Collo ($\frac{6}{1}$ oder $\frac{6}{2}$ u. s. f.)

Translation:

W. A. 1873, Vienna.

To the Chief Manager of the Universal Exhibition, 1873. Vienna.

Place of Exhibition:
(for instance: Industrial Palace, Park, or Machinery Hall.)

Name or firm of the exhibitor.
Country and place of residence.
Group.
Number of application for admission.
Number of package ($\frac{6}{1}$ or $\frac{6}{2}$ and so on.)

A list of the contents of each single package must be placed inside the package, in order that the objects may be put the more easily in their right place, and to facilitate the manipulation of the custom-house.

(28.) The commissions or the exhibitors themselves, or their agents, are responsible for the forwarding, receiving, and unpacking the packages, and the proper delivery of their contents; and afterward for the arrangement, surveyance, and returning the objects exhibited. Only those agents will be admitted who have proved to the Chief Manager that they are the authorized agents of the foreign commissions.

(29.) If the person who has to receive the goods is not present at the Exhibition when they arrive, they will be at once stored up at the cost and risk of the respective commission.

(30.) The motive power for engines and machinery will be placed gratis at the disposal of the exhibitors.

The necessary force of motion is transmitted by a horizontal revolving shaft, the position, diameter, and number of revolutions per minute of which will be published in time by the Chief Manager.

The exhibitors must furnish all the pulleys for this principal transmission, as well as the gearing necessary, together with the cross-shafts pulleys, and straps.

A special regulation will be published for the machinery department.

(31.) The Chief Manager will, if desired, give the name of contractors who have applied to him for the execution of the arrangements of the Exhibition; yet the Chief Manager will take upon himself no responsibility for their performances; the exhibitors have, nevertheless, the right to choose their own contractors and workmen.

(32.) Packages or empty cases cannot be deposited upon the space necessary for circulation. The packages must be unpacked directly after their arrival, and the packing-cases and materials must be removed at once.

(33.) Between the 15th February and the 25th April, 1873, the objects already lying on the Exhibition grounds, and unpacked, must be put in order and arranged.

In order to have the objects equally apportioned in the spaces of the Exhibition, the Chief Manager reserves to himself the right, on the 25th of April, to dispose of those places which do not contain sufficient objects.

The days from the 26th to the 29th April, will be employed in cleaning the localities and in inspecting the whole Exhibition.

(34.) There will be published special regulations for the arrangement and erection of those products and objects which will be exhibited in the park.

Roads of communication and earth-works may only be constructed and made according to the plans arranged between the Chief Manager and the foreign commissions.

IV.—ADMINISTRATION AND SUPERINTENDENCE.

(35.) The objects will be exhibited under the name of the manufacturer. If the manufacturer agrees to it, they may also be exhibited under the name of the business man who has them in warehouse.

(36.) The exhibitors are invited to add to their name or firm, also the name of those persons who have taken a notable part in the production of an object, either as inventors, draughtsmen, or modelers.

(37.) The exhibitors are also invited to quote the price in cash, and place of sale, on the objects exhibited.

(38.) The Chief Manager has taken the necessary steps that the objects exhibited may, from the time of their arrival on the exhibition-grounds until taken away, (*vide* No. 12 of these regulations,) enjoy the benefit of the laws existing in Austria for the protection against piracy of inventions and designs, for instance, of the patent and registration law. Detailed regulations will be published.

Reproductions (designs, photographs, &c.) of objects exhibited are only allowed, if the exhibitor and the Chief Manager consent to it.

(39.) It is left to the exhibitors to insure the objects exhibited, against damage by fire, at their own expense.

(40.) The Chief Manager will make provision for preserving from damage the products exhibited, as far as possible; he will also appoint persons to take care of the objects. Nevertheless, the Chief Manager will take upon himself no responsibility for damage of any kind whatever.

(41.) Each exhibitor will receive a ticket, entitling him to free admittance.

Any agent, duly appointed by the exhibitor, will also receive a ticket entitling him to free admittance.

An agent representing more than one exhibitor, can only obtain one ticket.

The arrangements concerning the distribution and the control of tickets will be published later on.

(42.) A special regulation will be published for the arrangement of the interior service.

51. *Admission tickets.*—The following were the official regulations regarding the admission tickets, &c.:

(1.) The Universal Exhibition at Vienna, 1873, will be opened on May the 1st, 1873, and will be closed on October the 31st, 1873.

(2.) The hour of opening and closing the Exhibition will be made known on the first day of each month.

(3.) The entrances to the Exhibition are: 1. Through the Wurstelprater at the west portal of the Industrial Hall. 2. Through the west-portal of the Machinery Hall, at the end of the Ausstellungs-strasse, (Exhibition-road.) 3. South portal in the Prater Hauptallee. 4. Entrance at the Rondeau. 5. Exhibition station.

(4.) The holders of season and weekly tickets go through the west and south entrances.

(5.) No money is changed at the entrance-gates.

(6.) Season-tickets are not transferable, and each can be used only by the person who signed it. For season tickets which have been lost, no compensation is allowed.

(7.) The holder of a season ticket, by indorsing it, submits to all these regulations.

(8.) The office for season tickets is opened on the 21st of April, at 42 Prater-strasse, and tickets will be issued from this date.

(9.) Any ticket issued by any other person than the one for whom it has been issued will at once be confiscated, and legal proceedings will be taken against the holder.

(10.) The weekly tickets, with seven coupons, have to be used for seven consecutive days, and cost five florins, ($2.36½.) The holder of a weekly ticket may use it either by going on seven consecutive days, once daiy to the exhibition, or several persons may go together, when as many coupons have to be taken as persons are admitted on the ticket, until the last coupon is used.

(11.) The issue of weekly tickets commences on the 2d of May, but the tickets cannot be used for admission until the 4th of May.

(12.) No cards for re-admission will be issued.

(13.) The entrance-fees are for Sundays and feast-days, 50 kreutzers, (0.395,) and on any of the week-days one florin, O. W., ($0.473.) The days of the opening, and of the distribution of prizes are, however, excepted; on these days the entrance-fees are 25 florins, ($11.82½.) On the 2d and 3d of May the entrance-fees are 5 florins, ($2.36½,) and on the 4th of May 2 florins, (0.94\frac{6}{10}$.) A season ticket for the whole time of the exhibition costs 100 florins ($47.30) for a gentleman, and 50 florins ($23.65) for a lady. Tickets for ladies, however, are given to those gentlemen only who are already holders of season tickets.

(14.) Tickets for exhibitors are issued to each exhibitor or to his representative accepted by the Exhibition authorities, according to the regulations of January 27, 1872.

(15.) Agents or representatives of exhibitors are accepted, however, only by a written request of the latter, and this request has to be made through the commission to which the exhibit belongs; only in this case a ticket will be given to the representative. The exhibitor is responsible for any improper use that may be made of the ticket.

(16.) Exhibitors or representatives of exhibitors who are not established at Vienna, will receive tickets only for the time of their staying at Vienna.

(17.) Every single exhibitor of a collective exhibition is entitled to a ticket, while collective firms can claim one ticket only.

(18.) To workmen or attendants who are actually engaged in the Exhibition, monthly tickets are issued for the time of their occupation. The price for such a monthly ticket is 6 florins, (2.83\frac{8}{10}$.)

(19.) Exhibitors of temporary exhibitions will receive tickets only for the time of their temporary exhibitions.

(20.) The tickets for the jury and the experts of the jury are valid from the 1st of May to the last of August.

(21.) The President, the Vice-President, the members of foreign commissions, as well as the representatives of the press, receive honorary tickets.

(22.) The necessary number of tickets is given to each foreign commission for the administrative staff of its department.

(23.) Also the members of the Imperial Commission, as well as the commission for the exhibitions from the crown counties, if they have taken already season tickets, will be provided with honorary tickets. The members of the commission for the exhibition from the crown counties receive, however, tickets for the time of their staying at Vienna, only.

(24.) With the exception of the weekly tickets, all other tickets have to be received and signed personally, at the office for the issue of tickets. If the holder of a season ticket gives his written authorization, his ticket may be received at the ticket-office, 42 Prater-strasse, by any person appointed by him. No cards are forwarded.

52. *General Calendar.*—The following is the calendar of the exhibition:

1870.

May 24.—Imperial and Royal Order constituting the Universal Exhibition, 1873.

1871.

Jan. 9.—Appointment of the Chief Manager.

July 21.—Publication of the law concerning the Exhibiton fund.

Aug. 1.—Opening of the offices of the Chief Manager.

Sept. 14.—Appointment of the Imperial Commission.
Publication concerning the formation of local committees.

Sept. 16.—First meeting of the Imperial Commission.

Oct. 4.—Publication of the Imperial charter of the Exhibition.

1872.

Feb. 15.—Sending of the plan of the Exhibition buildings and of the park to the Austrian local committees and foreign commissions for the Exhibition.

May 1.—Communication to the Chief Manager of the space required by the foreign commissions.
Communication to the Chief Manager of the reductions obtained by the foreign commissions from the steam-navigation and railway companies for the conveyance of goods and passengers.

July 1.—Communication to the foreign commissions of the definitive allotment of space.
Latest term for Austrian exhibitors to forward their applications for space to the respective local committees.
Publication by the Chief Manager of the reductions obtained from all the steam-navigation and railway companies for the conveyance of goods and passengers.

1872.

Aug. 1.—Latest term for the Austrian local committees of the Exhibition to forward the lists of exhibitors to the Chief Manager.

Oct. 1.—Latest term for the Austrian local committees and foreign commissions to forward detailed plans showing the subdivisions (groups) to the Chief Manager.

Oct. 31.—Sending of the certificates of admission to Austrian exhibitors.

1873.

Jan. 1.—Latest term for forwarding to the Chief Manager the lists of foreign exhibitors and the detailed plans showing each single exhibition.

Latest term for the foreign commissions and Austrian local committee to send the information necessary for compiling the catalogue.

Jan. 31.—Latest term for application for space for erecting special stables for the cattle and horse show.

Feb. 1–April 15.—Admission of Exhibition goods in the Exhibition grounds.

Feb. 15.—Latest term for completing all preparations made to receive Exhibition goods.

Feb. 15–April 25.—Arrangement of the Exhibition goods.

Feb. 28.—Latest term for the entering of animals in general.

April 26–29.—Cleaning of the buildings and revision of the whole Exhibition.

April 30.—Latest term for the entering of brood-mares.

May 1.—Opening of the Exhibition.

May 1–10.—First flower-show; exhibition of hot-house and preserved fresh fruits.

May 31–June 9.—Exhibition of horned cattle, sheep, pigs, goats, asses.

June 15–25.—Second flower-show; exhibition of berry-fruit and cherries.

August 20–30.—Third flower-show; exhibition of plums and early pears.

Sept. 18–23.—Fourth flower-show; exhibition of plums, of autumn-pears, and apples.

Sept. 18–27.—Exhibition of horses, poultry, pigeons, dogs, cats, fish, &c.

Sept. 21, 23.—International horse-races.

Oct. 1–15.—Exhibition of the products of nursery-gardens and of vineyards.

Oct. 4–6.—Exhibition of game.

Oct. 31.—Close of the Exhibition.

Dec. 31.—Latest term for the removal of goods exhibited.

1874.

June 30.—Sale of the unremoved goods which have been left after the close of the exhibition.

Calendar for group 2.—Agriculture, forestry, cultivation of the vine and of fruits and horticulture.

1872.

July 1.—Publication of the reductions of fares for goods and passengers by steam and rail.

Latest term for Austrian exhibitors* to forward their entries to the respective local committees.

Aug. 1.—Latest term for Austrian local committees of the Exhibition to forward the lists of exhibitors to the Chief Manager.

1873.

Jan. 1.—Latest term for forwarding lists of foreign exhibitors to the Chief Manager.

Jan. 31.—Latest term for application for space for erecting special stables for the cattle and horse show.

Feb. 28.—Latest term for the entering of animals in general.

April 30.—Latest term for the entering of brood-mares.

May 1–10.—First flower-show; exhibition of hot-house and preserved fresh fruit.

May 31–June 9.—Exhibition of horned cattle, sheep, pigs, goats, and asses.

June 15–25.—Second flower-show; exhibition of berry-fruit and cherries.

Aug. 20–30.—Third flower-show; exhibition of plums and early pears.

Sept. 18–23.—Fourth flower-show; exhibition of plums, autumn pears, and apples.

Sept. 18–27.—Exhibition of horses, poultry, pigeons, dogs, cats, fish, &c.

Sept. 21, 23.—International horse-races.

Oct. 1–15.—Exhibition of the products of nursery-gardens and of vineyards.

Oct. 4–6.—Exhibition of game.

53. *Calendar of International Congresses.*

1873—June 16, 17, 18, 19, 20, 21.—International brewers' convention.

July 7, 8, 9, 10, 11, 12.—International congress for discussing the question of a uniform notation of yarns.

August 3, 4, 5, 6, 7, 8.—International congress of instructors and directors of institutions for the blind.

August 3, 4, 5.—International patent congress.

August 11, 12, 13, 14.—International congress for national economy.

August 19, 20.—International congress for the flax interests.

August 18, 21.—International congress of the linen industries.

August 18.—Spinning and weaving.

August 21.—Bleaching, dyeing, and finishing.

August 24, 25, 26, 27.—International convention of miners and metallurgists.

*Application for space for the cattle and horse show *vide* 28 February and 30 April, 1873.

A competition for prizes to be awarded for the best instruments for cultivating and raising sugar-beet roots was instituted, of which the programme was as follows:

(1.) Austro-Hungarian beet-root-sugar manufacturers and cultivators of sugar-beet roots have opened a subscription and put at the disposal of the undersigned Chief Manager a considerable amount, to be distributed as prizes, on the occasion of the Universal Exhibition of 1873, for the best instruments for cultivating and raising sugar-beet roots.

(2.) The competition comprises all machines and instruments necessary for cultivating and raising beet-roots.

(*a*) A beet-root drill depositing the seed in tufts, eventually combined with a distributor for artificial manure.

(*b*) An instrument (harrow or roller) which, without injuring the beet-roots, pulverizes the soil, hardened by showers, and facilitates the thriving of the plants.

(*c*) A hoe for hoeing the weeds as soon as the beet-root begins to shoot, and a scarifier for destroying the weeds, and, at the same time, for loosening the soil to a greater depth.

(*d*) A machine for raising beet-roots which acts without damaging them.

(*e*) An instrument (tool) for cutting off the tops of the beet-roots, and which may, at the same time, be used for cleaning the beet-roots.

(*f*) A hand-instrument for cutting up beet-roots.

(*g*) A hand-instrument for raising beet-roots.

(3.) The competitors can either compete for all the machines and instruments enumerated, or only for one or more of the same.

(4.) The following prizes will be awarded:

	Florins Austrian currency.
(*a*) For the two best beet-root drills, two prizes of	2,000 and 1,000
(*b*) For the best harrow or roller for pulverizing the soil, a prize of	500
(*c*) For the best weeding-machine, a prize of	1,000
(*d*) For the two best scarifying-machines, two prizes of	1,000 and 500
(*e*) For the two best beet-root-raising machines, two prizes of	3,000 and 2,000
(*f*) For the best instrument (tool) for cutting off the tops and cleaning the beet-roots, a prize of	200
(*g*) For the best hand-instrument for cutting up beet-roots, a prize of	200
(*h*) For the best hand-instrument for raising beet-roots, a prize of	300
	6,000 and 5,700
	11,700

(5.) The prize-donors having the greatest interest in the success of the competition, will also appoint the jury for judging the machines

sent for competition. The undersigned Chief Manager will send in due time the invitations to the prize-givers.

(6.) The jury will be composed of five members, out of whom the Chief Manager will appoint a president. All business will be done in the usual manner.

(7.) Prizes can only be awarded to those instruments which have really been worked with in the field, and which have been judged accordingly. In consequence the jury, together with the Chief Manager, will choose the beet-root fields where these trials will have to be made. Care will be taken that those machines which will have been constructed for a special kind of soil, only work in that soil, while those which ought to be fit for every kind of soil, will be tried in different kinds.

(8.) The competing machine-manufacturers must send all machines and instruments, excepting the raising-machines, &c., at the beginning of the month of March, 1873, to the undersigned General Direction. Beet-root-raising machines may be sent until the beginning of September.

(9.) The award and distribution of prizes will take place in the course of the month of October, or at the latest during the month of November, 1873.

(10.) The principle of the jury must be to award prizes only to those machines and instruments which are quite adapted to their purpose. If no such machines and instruments be sent, or if they only be reproductions of instruments for the cultivation and raising of beet-roots already known, no prizes will be awarded.

(11.) Consequently if one or more prizes be not awarded in the year 1873, there will be another competition the next year, and the jury, in that case, will again have to distribute the prizes, or else another competition will take place the year following.

(12.) Moreover a sum of 300 florins will be placed at the disposal of the jury, to be awarded for machines and instruments which are not mentioned in art. 2, but which have been sent for this competition, and which are particularly adapted to the purpose.

(13.) The above-mentioned special jury and the International Jury of the Universal Exhibition, 1873, are entirely independent of each other, and the money-prizes distributed by the former differ totally from the prize-medals awarded by the latter. The machine-manufacturers who compete for these money-prizes have, therefore, the right to exhibit duplicates of their instruments at the Universal Exhibition of 1873, in order to have them judged also by the International Jury and to compete for the prize-medals, which are awarded by the latter in accordance with the general programme of the Exhibition.

54. *Machinery Hall.*—Special regulations for the Machinery Hall were issued as follows:

(1.) The Machinery Hall is destined for the exhibition of objects belonging to Group 13, (machinery and means of transport.)

Machinery and apparatus molesting the public or likely to damage

other objects of exhibition, or which are in any other way not consistent with the object and arrangement of the exhibition in the Machinery Hall, will not be admitted in the hall.

Such machines can only be exhibited outside the Machinery Hall, either in the open air or in a covered space, at the expense of the exhibitors.

(2.) The exhibitors of machinery and apparatus have, on application, to state:

(*a*) Area of the space required, giving length and breadth in meters;

(*b*) Wall-space required, giving length and breadth in meters;

(*c*) Power required, in actual horse-power of 75 kilogram-meters or:

(*d*) Quantity of steam required in kilograms or cubic meters per hour and steam-pressure in atmospheres;

(*e*) Quantity of water required, in cubic meters, per hour;

(*f*) Quantity of gas required, in cubic meters, per hour.

(3.) Foreign commissions are requested to give notice, to the Chief Manager, of all machinery intended to be set in motion, at the latest, by the 1st August, 1872.

(4.) Objects for exhibition will be admitted to the Machinery Hall from the 1st of February to the 15th April, of 1873, inclusive, and must be set up, at the latest, by the 25th of April.

Machines and apparatus arriving in pieces and consisting of heavy and bulky parts must be set up by the 15th of April.

Brick-work foundations are to be built at the cost of the exhibitors, and must be finished and ready for receiving the machinery by the 15th of March, 1873.

(5.) In the interior of the Machinery Hall and adjoining it are railway sidings, so that goods for exhibition may be conveyed in trucks to the immediate vicinity of the place of their exhibition.

(6.) Travelling-cranes will be employed on the railway sidings for the unloading and erection of machinery.

Care will, moreover, be taken that travelling-cranes on raised rails will be supplied and ready for use in the Machinery Hall.

The use of these auxiliary machines can be allowed only according to the directions of the Chief Manager, and on payment of a stipulated fee.

(7.) The Machinery Hall will have a strong boarded floor, constructed at the cost of the Exhibition fund, (in the central gallery of 2½ inches, in the side galleries 1½ inches thick,) on a solid foundation, so that even heavy machinery can be set up without any extra foundation.

(8.) The power required to set machinery and main shafting for driving machinery in motion, will be supplied free of charge by the general direction.

The conditions for the supply of steam, water, or gas will be regulated, as the case may be, by special agreement with the Chief Manager.

(9.) The moving force will be transmitted by two horizontal shafts.

These shafts will have a diameter of 0.09 meter and 120 revolutions

per minute, and be situated 4.5 meters above the floor and supported by columns.

The position of the shafting in the Machinery Hall is shown in an accompanying sketch.

(10.) The exhibitors have to supply the pulleys for the main shafts, as well as any other gear and driving-bands, at their own cost.

The pulleys to be applied to the main shafting are to be made in two parts for screwing together.

These pulleys are to be fastened to the main shafting in such a way that no injury is done to the shafts.

(11.) Machinery intended to be worked is to be placed in the central gallery of the Machinery Hall.

The machinery of each country is moreover to be so arranged in this place of exhibition that the machinery intended to be worked should be placed in uninterrupted succession.

The main shafts will be carried only to such a length as may be equired by the extent of these groups.

The maximum length of main shafting apportioned to each country will be made known to the commissions by the 31st of August, 1872.

(12.) The preservation, cleaning, and oiling of the main shafts will be attended to by the General Direction; but exhibitors will have to attend to the preservation and oiling of the gear supplied by them, as also to the preservation of their straps.

(13.) The stage carrying the main shafts will be constructed in such a manner that any pulleys or other gear required may be easily attached to it.

Before applying such gear the exhibitor has to submit the plans of his intended arrangements.

The Chief Manager reserves to himself the right, for the sake of uniformity of arrangement, to make any necessary alterations in these plans.

(14.) If machinery has to be worked, and the power cannot be supplied by the main shafts, then underground shafts or other arrangements will be made, subject to a special agreement between the exhibitor and the Chief Manager.

(15.) Special arrangements will be made, as the case may require it, for the application of power for machinery to be worked outside the Machinery Hall.

(16.) The hours during which daily machinery can be worked will be published before the opening of the Exhibition.

Exhibitors have to notify the persons whom they purpose to intrust with the working of and attending to the machinery.

Nobody except these attendants will be allowed to work the machinery.

(17.) All machinery intended to be worked must, at the expense of the exhibitor, be guarded by railings or other proper means, in order to protect the public from injury.

(18.) Machinery and apparatus, fit for the special service of the Exhibition may be supplied by exhibitors for this express object, and will be ranged as objects of exhibition in group 13.

Among such machinery and apparatus may be here specified:

(*a*) Boilers for the production of steam for engines;

(*b*) Steam-engines for driving the main shafting in the Machinery Hall;

(*c*) Gas-engines and water-power for driving single machines and groups of machines;

(*d*) Large and small pumps for water-works and fountains;

(*e*) Travelling-cranes with normal gauges of 1.5 meters for the service in the Machinery Hall;

(*f*) Overhead travelling-cranes with winch and moving gear with a gauge of 10.5 meters from rail to rail for the erection of heavy pieces for the Machinery Hall;

(*g*) Hydraulic lifts for raising persons;

(*h*) Portable engines for the service outside the Machinery Hall.

(19.) Exhibitors supplying such machines and apparatus intended for special service during the Exhibition will enjoy special privileges to be arranged, as occasion may require, between them and the Chief Manager.

(20.) Machinery and apparatus supplied for special service during the exhibition will be examined by a committee appointed by the General Direction, and, in particular in the case of steam-boilers, the consumption and the evaporative power will be expressed in figures.

The working-power of steam and gas engines will be examined by the indicator or by dynamometrical measurement.

The result of these examinations will, if desired by the exhibitor, be published.

(21.) For the convenience of exhibitors a small workshop, consisting of a turnery shop, fitting-shop, grinding-shop, smithy and copper-smithy, will be arranged within the Exhibition-grounds in the vicinity of the Machinery Hall.

In these workshops, according to the means at hand, small works or repairs may be executed.

The administration of the workshops is under the control of the General Direction, and work intrusted to them for execution will be calculated according to a tariff fixed by the General Direction.

(22.) The stipulations of the general regulations remain in full force in addition to the stipulations contained in these special regulations.

55. *Reduction of fares.*—A reduction of fares for goods and passenger traffic by steam and rail was secured. The following circular indicates its extent:

REDUCTION OF FARES.

Pursuant to the negotiations entered into by the Chief Manager of the Universal Exhibition, and in accordance with paragraph 11 of the gen-

eral regulations for exhibitors of the Austro-Hungarian monarchy, and paragraph 9 of the general regulations for foreign exhibitors and commissions, with the railway and steam-navigation companies of Austro-Hungary and foreign countries, the reductions summarily stated here below have been provisionally agreed to. The result of further negotiations in this direction will be made known in due time.

A.—AUSTRO-HUNGARIAN RAILWAY AND STEAM-NAVIGATION COMPANIES.

(1.) The Austrian State Railway, (österr. Staatseisenbahn-Gesellschaft,) the Southern Railway, (Südbahn-Gesellschaft,) the Northern and Moravian-Silesian Railway, (Kaiser Ferdinands- und mährisch-schlesische Nordbahn,) the Bohemian Western Railway, (böhmische Westbahn,) the Galician Railway, (galizische Carl Ludwigbahn,) the Lemberg-Czernowitz-Jassy Railway, (Lemberg-Czernowitz-Jassy-Eisenbahn,) the St. Valentin-Bruck-Laibach Railway, (Kronprinz Rudolphbahn,) the Vienna-Prague, Vienna-Eger Railway, (Kaiser Franz Josephsbahn,) the Austrian North Western Railway and the Southern North German Junction Railway, (österreichische Nordwestbahn und süduorddeutsche Verbindungsbahn,) the Western (Vienna-Salzburg) Railway, (Kaiserin Elisabethbahn,) the Graz-Köflach Railway, (Graz-Köflacher Bahn,) the Teplitz Railway, (Aussig-Teplitzer Bahn,) the Dux-Bodenbach Railway, (Dux-Bodenbacher Bahn,) the Northern Bohemian Railway, (böhmische Nordbahn,) the Turnau-Kralup-Prague Railway, (Turnau-Kralup-Prager Bahn,) the Buschtěhrader Railway, (Buschtěhrader Bahn,) the Hohenstadt-Zöptau Railway, (Hohenstadt Zöptauer Bahn,) the Brünn-RossitzRailway, (Brünn-Rossitzer Bahn,) the Ostrau-Friedland Railway, (Ostrau-Friedländer Bahn,) the Fünfkirchen-Bares Railway, (Fünfkirchen-Bareser Bahn,) the Gramat-Neusiedel Railway, (Gramat-Neusiedler Bahn,) the Mohacs-Fünfkirchen Railway, (Mohacs-Fünfkirchner Bahn,) the Theiss Railway, (Theiss-Eisenbahn,) the Western Hungarian Railway, (ungarische Westbahn,) the Eastern Hungarian Railway, (ungarische Ostbahn,) the North-Eastern Hungarian Railway, (ungarische Nordostbahn,) the Kaschau-Oderberg Railway, (Kaschau-Oderberger Bahn,) the I. Transylvanian Railway, (I. Siebenbürger Bahn,) will charge:

(*a*) For goods conveyed by goods-trains both for inland and foreign traffic, either to or from the Exhibition, 0.8 kreutzer, Austrian silver currency, per zollcentner* per German mile, including booking;

(*b*) For goods conveyed by express-trains, 3 kreutzer, Austrian silver currency, per zollcentner, per mile, including incidental expenses;

(*c*) For vehicles, 0.8 kreutzer, Austrian silver currency, per zollcentner, per mile, as per existing tariff calculated in normal weights;

(*d*) For rolling-stock, running upon the line, 0.5 kreutzer, Austrian silver currency per zollcentner, per mile;

* 1 Zollcentner = 50 kilograms.

(*e*) For beasts, per head and per mile, as follows: Horned cattle and asses, 9.6 kreutzer, silver currency; calves, 4.8 kreutzer, silver currency; calves, sucking, 0.8 kreutzer, silver currency; pigs, fattened, 4.8 kreutzer, silver currency; pigs not fattened, 1.6 kreutzer, silver currency; pigs, sucking, 0.8 kreutzer, silver currency; lambs and kids, 1.6 kreutzer, silver currency; sheep and goats, 1.6 kreutzer, silver currency; dogs, 2.4 kreutzer, silver currency; horse, foal and mule, (single,) 20.8 kreutzer-silver currency; horses, foals and mules, (in numbers,) 10.4 kreutzer, silver currency; poultry in coops according to the actual weight per zollcentner per German mile, 0.8 kreutzer, silver currency.

(*f*) Drovers will be charged the half-fare for third-class carriages to or from the Exhibition.

(*g*) With regard to the advantages to accrue to passenger traffic, most of the railway companies have declared their willingness to introduce limited extra trains, with a reduction of fares of at least 50 per cent.

As regards special reductions of fares for exhibitors, the aforementioned railway companies reserve to themselves the right, conjointly, of making further arrangements.

For the conveyance of provisions, the several railway companies terminating in Vienna will arrange express-goods trains, as may be required.

For the Vienna Junction Railway, (Verbindungsbahn,) the charge of 0.8 kreutzer, silver currency, per zollcentner, has been fixed.

Charges for the traffic between the Western Railway Station (Elisabethbahnhof) and State Railway Station, (Staatsbahnhof:)

For the distance Penzing-Hetzendorf, 0.6 kreutzer, silver currency.

For the distance Hetzendorf-Southern Railway Station, 0.4 kreutzer, silver currency.

For the distance Southern Railway Station to State Railway Station, 0.4 kreutzer, silver currency.

From the State Railway Station to the Exhibition, for the distance of 1.5 mile, the generally adopted rate of 0.8 kreutzer, silver currency, per zollcentner pe mile.

For the traffic between the Western Railway Station and the Northern Railway Station there will be charged:

For the distance Penzing-Hetzendorf, 0.6 kreutzer, silver currency.

For the distance Hetzendorf-Southern Railway Station, 0.4 kreutzer, silver currency.

For the distance Southern Railway Station to Northern Railway Station, (charges of the Junction Railway,) 0.8 kreutzer, silver currency, per zollcentner.

From the Northern Railway Station to the Exhibition the charge will be, per zollcentner, 0.7 kreutzer, silver currency.

(2.) The directors of the Royal-Hungarian State Railways, (königlich-ungarische Staatsbahn,) have agreed to a reduction of the tariff for goods for the Exhibition, as follows:

(*a*) For the conveyance of goods, per goods-train, the rate of 0.8 kreutzer, silver currency, the aliquot parts of 10 pounds will be charged as 10 pounds, the minimum weight to be 50 pounds;

(*b*) For goods per express-train, 3 kreutzer, silver currency, the aliquot parts of 10 will be charged as 10 pounds, minimum rate 20 kreutzer, including incidental expenses;

(*c*) For beasts the following tariff: Oxen, cows, bulls, and asses, irrespective of numbers, per head and mile, 12 kreutzer, silver currency; sucking calves, with the cows, per head and mile, 2 kreutzer, silver currency; calves, without the cows, per head and mile, 6 kreutzer, silver currency; pigs, young and sucking, per head and mile, 1 kreutzer, silver currency; pigs, not fattened, per head and mile, 2 kreutzer, silver currency; pigs, fattened, per head and mile, 6 kreutzer, silver currency; lambs and kids, per head and mile, 1 kreutzer, silver currency; sheep, rams, goats and he-goats, per head and mile, 2 kreutzer, silver currency; dogs, per head and mile, 3 kreutzer, silver currency; horse, foal and mule, (single,) per head and mile, 26 kreutzer, silver currency; horses, foals and mules, (in numbers,) per head and mile, 13 kreutzer, silver currency; Poultry, in coops, according to the actual weights, per zollcentner and mile, 1 kreutzer, silver currency, including incidental charges and truck-cleaning.

(*d*) Drovers will be charged the half-fare for third-class carriages to or from the Exhibition.

(*e*) For vehicles, tariff-rates as per normal weights of, 0.8 kreutzer, silver currency, per zollcentner and mile, including booking.

(*f*) For rolling-stock, running on the line, the fixed rate of 0.5 kreutzer, silver currency, per zollcentner and per mile.

(*g*) Exhibitors travelling in second and third class carriages will be charged the half-fare to or from the Exhibition.

(3.) The Imperial Royal Danubian Steam-Navigation Company have agreed to the following reductions for objects of exhibition and live beasts, viz:

(*a*) Upon all goods a reduction of two-thirds of the normal rate of freight.

(*b*) Upon live beasts a reduction of freight of 50 per cent.

As regards the conveyance of passengers, travelling exhibitors will be allowed a reduction of 50 per cent. of the usual rates to or from the Exhibition, (express boats excepted.)

(4.) The Austrian Lloyds Steam-Navigation Company will allow upon goods and live beasts for the Exhibition a reduction of 50 per cent. off the tariff, and exhibitors travelling will be allowed a reduction of 50 per cent. off the tariff of the first and second class fares, including express boats.

B.—Foreign traffic arrangements.

The Warsaw-Vienna and Warsaw-Bromberg Railway Company allow a reduction of 50 per cent. in the following manner, *i. e.*, for goods conveyed to the Exhibition, the full rate of freight must be paid, but on

their being returned from the Exhibition, no charge will be made for freight.

The royal Prussian minister of commerce, industry, and public works has allowed, by a rescript of the 20th February, c. No. II, 2729, with reference to the state-railways and railways under the administration of the government, that objects intended for the Universal Exhibition, 1873, in Vienna, whether they proceed from inland or foreign countries, shall be conveyed both to and from the Exhibition for half the freight fixed per tariff, on condition that on their way to the Exhibition they be addressed to one of the collecting stations of the German Empire, or to the Exhibition commission of the respective countries in Vienna, and that on their being returned from the Exhibition they be addressed to one of the aforementioned collecting stations or to the exhibitor or to the consignor at the original place of departure.

In the first case, they must be provided with a certificate of admission, and in the latter case, with a return-certificate, testifying that they are Exhibition goods.

Subsequently a second circular was issued as follows:

The reduction of fares provisional agreed to by the several inland and foreign railway and steam-navigation companies, previous to the 15th of March, was published in programme No. 47.

In accordance with paragraph 11 of the general regulations for exhibitors of the Austro-Hungarian monarchy, and with paragraph 9 of the general regulations for foreign exhibitors, the undermentioned new series of tariff reductions having been agreed to by the respective companies are now published. The tariff reductions of those companies not yet officially notified to the General Direction, will be supplementary published.

A.—Austro-Hungarian Railway and steam navigation companies.

In consequence of subsequent resolutions of the Austro-Hungarian railway companies, the tariff reductions provisional agreed to for the conveyance of Exhibition goods, and published on the 15th March in programme No. 47, are now cancelled, and the following revised tariff reductions take their place, namely:

(1.) All the railway companies of the Austro-Hungarian monarchy agree to convey objects and live-cattle, intended for exhibition, both to, and, if such remain unsold, from the Exhibition to the orginal place of departure, at a reduction of 50 per cent. from the present fixed rates of freight per fast or goods trains. In addition to this it is agreed, with respect to the freight of ordinary goods, that in no case will a higher tax be imposed than 1 kreutzer, Austrian currency, per zollcentner and mile, including booking.

Drovers will be charged the half-fare for third-class carriages to or from the Exhibition.

With regard to the advantages to accrue to passenger traffic, it was decided that by extra trains (for exhibitors and visitors) there will be a reduction of 50 per cent. from the ordinary fares.

For the conveyance of provisions, the several railway companies terminating in Vienna will arrange express-goods trains, as may be required.

The following rates of freight, as published March 15, 1872, in programme No. 47, remain unaltered, namely:

The charge will be from the Northern Railway Station to the Exhibition 0.7 kreutzer per zollcentner, silver currency;

The charge will be from the State Railway Station to the Exhibition 1.2 kreutzer per zollcentner, silver currency;

The charge will be from the Southern Railway Station to the Exhibition 1.6 kreutzer per zollcentner, silver currency;

The charge will be from the Western Railway Station to the Exhibition:

(*a*) In Northern Railway, 2.5 kreutzer per zollcentner, silver currency;

(*b*) In State Railway, 2.6 kreutzer per zollcentner, silver currency:

(2.) The Imperial Royal Danubian Steam-Navigation Company have agreed to the following reductions for Exhibition goods, namely:

(*a*) Upon all goods a reduction of two-thirds of the normal rate of freight;

(*b*) Upon live beasts a reduction of freight of 50 per cent.;

(*c*) Exhibitors travelling to or from the Exhibition will be allowed a reduction of 50 per cent. off the usual rates, (express-boats excepted,) as already specified on the 15th March, 1872, in programme No. 47.

(3.) The Austrian Lloyds Steam-Navigation Company will allow upon goods and live beasts for the Exhibition (as already mentioned on the 15th of March, 1872, in programme No. 47) a reduction of fifty per cent. off the tariff, and exhibitors travelling will be allowed a reduction of fifty per cent. off the tariff of first and second class fares, including express-boats.

B.—Foreign traffic arrangements.

The directions of the:

(1.) Rhenisch-Thüringen Union traffic, namely:
- (*a*) The Bergisch-märkische Railway in Elbersfeld,
- (*b*) The Westphalian Railway in Münster,
- (*c*) The Hessian Northern Railway in Cassel,
- (*d*) The Thüringen Railway Company in Erfurt,
- (*e*) The Leipzig-Dresden Railway Company in Leipzig,
- (*f*) The Royal State Railways of Saxony in Dresden;

(2.) Hamburg-Berlin-Austrian traffic, namely:
- (*a*) The Berlin-Hamburg Railway Company in Berlin,
- (*b*) The Lower Silesian-märkische Railway in Berlin,

(*c*) The Upper Silesian Railway in Breslau,
(*d*) The Leipzig-Dresden Railway Company in Leipzig,
(*e*) The Berlin-Anhalt Railway Company in Berlin,
(*f*) The Royal State Railways of Saxony in Dresden,
(*g*) The Lübeck-Buchen Railway in Lübeck;

(3.) Stettin-Austro-Hungarian traffic, namely:
(*a*) The Upper Silesian Railway in Breslau,
(*b*) The Berlin-Stettin Railway in Stettin;

(4.) Saxony-Austria traffic *via* Bodenbach, namely:
(*a*) The Magdeburg-Köthen-Halle-Leipzig Railway Company in Magdeburg,
(*b*) The Leipzig-Dresden Railway Company in Leipzig,
(*c*) The Royal State Railway of Saxony in Dresden;

(5.) Prussian-Silesian-Austro-Hungarian traffic, namely:
(*a*) The Upper Silesian Railway in Breslau,
(*b*) The Royal-Prussian Eastern Railway in Bromberg;

(6.) Bremerhaven-Gestemund-Bremen-Hamburg-Austrian traffic, namely:
(*a*) The Royal Hanoverian Railway in Hanover,
(*b*) The Brunswick Railway Company in Brunswick,
(*c*) The Magdeburg-Halberstadt Railway Company in Magdeburg,
(*d*) The Magdeburg-Leipzig Railway Company in Magdeburg,
(*e*) The Leipzig-Dresden Railway Company in Leipzig,
(*f*) The Royal State Railways in Dresden;

(7.) South German traffic:
(*a*) The Royal Bavarian State Railways in Munich,
(*b*) The Royal Bavarian privileged Eastern Railway in Munich,
(*c*) The Grand-duchy of Baden State Railway in Carlsruhe,
(*d*) The Hessian Ludwig Railway in Darmstadt,
(*e*) The Frankfort-Hanau Railway in Frankfort-on-Main,
(*f*) The Main-Neckar Railway in Darmstadt,
(*g*) The Bavarian Palatinate Railways in Ludwigshafen,

agree that objects intended for the Universal Exhibition, 1873, in Vienna, whether they proceed from inland or foreign countries or are directed to be forwarded by fast or goods trains, shall be conveyed both to and from the Exhibition for half the freight fixed per tariff, and will include the trains of union lines and international as well as local traffic—that is by dispatch from non-union stations.*

This concession, however, is granted on condition that, when the goods are dispatched they must either be addressed to one of the collecting stations of the German Empire or to the exhibition commissions of the respective countries in Vienna, and that on their return from

*Accessory charges of the South German Union railways, such as insurance, &c., will have to be paid in full.

the Exhibition, they must be addressed to one of the aforementioned collecting stations or to the exhibitor or to the consignor at the original place of departure.

In the first place they must be provided with a certificate of admission, and in the latter case with a return-certificate, testifying that they are goods intended for exhibition, that they were really exhibited there, and that they remained unsold.

N. B.—The Prussian state railways and railways under government control agree to allow to exhibitors and visitors a reduction of fares of fifty per cent.

8. The Warsaw-Vienna and Warsaw-Bromberg railway companies allow a reduction of fifty per cent. in the following manner, namely: the full rate of freight must be paid for goods conveyed to, but on their return from the Exhibition no freight will be charged.

9. The Royal Belgian state railways allow Exhibition goods of Belgian origin to be conveyed freight free, and a reduction of twenty five per cent. off passenger-fares.

The advantages thus offered by Belgium to the Royal State and Junction lines for goods intended for exhibition have not been previously published, and are accordingly hereby made known for the first time.

10. The Turkish Railway Company, Tschernawoda-Kustendji, allows for Exhibition goods dispatched to Vienna fifty per cent. reduction from the fixed tariff.

The Swiss, Dutch, Russian, and Italian railways intend likewise to grant a reduction of tariffs, but no official communication has yet been furnished. As soon as their decision shall have been received, they will be published immediately.

56. *The International Juries.*—The following were the regulations referring to juries:

I.—Examination of the objects exhibited.

The objects exhibited in Groups I to XXV, with the exception of those exhibited in Group XXIV, (*Exposition des amateurs*,) will be examined by an International Jury.

II.—Additional and temporary exhibitions.

Special juries, chosen from the members of the International Jury, will be formed for the following additional exhibitions:

1. History of inventions.
2. History of industry.
3. Statistics of prices.
4. Exhibition of the use of waste materials and their products.
5. Representation of the commerce and trade of the world.
6. The infants' pavilion.
7. Female work.

FIG. 1.—Medal for art.

FIG. 2.—Medal for good taste.

FIG. 3.—Medal for progress.

FIG. 4.—Medal for co-operation.

FIG. 5.—Medal for merit.

The reverse of all.

For the two last-named exhibitions ladies also may be invited to act on the jury as experts.

There will be no jury appointed for the Cremona instruments exhibited.

Special juries will be formed of members of the International Jury, in accordance with the several programmes for the temporary exhibitions of live-stock, dairy produce, horticulture, cultivation of the vine and of fruit.

III.—Appointment of jurors of the Austro-Hungarian monarchy.

The jurors of the kingdoms and countries represented in the Austrian Reichsrath will be elected, one-half by the exhibitors of each of the different groups, and the other half will be officially appointed. Should the number of jurors to be elected for one group be uneven, half of the total number, less one, will be elected.

The voting-papers must be sent sealed to the General Manager, who will submit them to the executive committee of the 16th section of the Imperial Exhibition Commission, who will act for the time as election committee.

The persons elected will be confirmed by His Imperial Highness the Archduke-President of the Imperial Exhibition Commission.

The selection of the officially appointed members of the jury will be made by His Imperial Highness the Archduke-President of the Imperial Exhibition Commission.

The mode of appointing the Hungarian members of the jury will be decided by the royal Hungarian government, and respectively by the Hungarian Exhibition Commission. The names of the jurors must be sent to the General Manager by the 15th of April next.

IV.—Nomination of jurors of foreign countries.

The foreign commissions for the Exhibition are invited to appoint in a manner they may deem most appropriate, the number of jurors allowed to their respective countries, and to send in the list of names to the General Manager not later than the 15th of April next.

V.—Number of jurors.

The number of jurors for Austria and Hungary, as well as for the different foreign countries, will be in proportion to the number of exhibitors of each State, as shown in the following table:

There will be chosen in each group: One juror for 10 to 100 exhibitors; two jurors for 101 to 200 exhibitors; three jurors for 201 to 300 exhibitors; four jurors for 301 to 400 exhibitors, &c., &c.

Every foreign country represented in the Exhibition is invited to nominate deputy jurors to take the place of any absent jurors. Should

a juror, as well as his substitute, be prevented from continuing their attendance at the meetings of the jury, His Imperial Highness the President of the Imperial Commission will, if necessary, fill up the vacancy.

The list of names of all the members of the International Jury will be published by the end of April, 1873.

VI.—Experts.

The section juries may increase their numbers by the addition of jurors from other sections of any of the different groups, and also by inviting the co-operation of experts who are not members of the jury.

The experts must be proposed at a full meeting forming a quorum of the respective section juries by a member or the representative of the Director-General, and elected by an absolute majority.

The names of these experts chosen will be published by the General Manager.

VII.—Representation of the General Manager at the jury meetings.

The General Manager will appoint delegates, who will be entitled to take part in the deliberations of the jury with a consultative voice. These delegates will have to provide everything necessary for the different trials and decisions of the jury.

VIII.—Representation of the foreign commissions at the jury meetings.

The commissioners of foreign states are entitled to take part in the deliberations of the jury, either personally or by a delegate appointed by themselves.

IX.—Sectional juries.

The classification of the groups published on the 16th September, 1871, will be taken as a basis for the proceedings of the jury. In order to facilitate the examination of the objects exhibited, the juries of the single groups will be subdivided into sections. (See pages 28, *et seq.*)

In judging the working-machines, (Group XIII, section 2,) as also the plans, models, and arrangements of industrial buildings and other objects to be examined from several points of view, competent persons, who are judges of the performances and productions of the respective machines, manufactories, &c., are to be selected from the other sections of the jury, with the right of voting.

X.—Organization and sphere of action of sectional juries

Each sectional jury on being constituted chooses from among its members a chairman, a deputy chairman, and one or more reporters.

A sectional jury can be constituted as soon as there are at least three regular members to form a quorum.

In default of this number of members the work of the section will be delegated by the group jury to one or several of the other sections.

Each sectional jury has to examine the objects which are classed in their respective sections, and to propose, after the completion of the examination, the prizes to be awarded.

These propositions must be submitted to the group jury for approval.

XI.—Organization and sphere of action of the group juries.

Every group jury is to consist of all the members of the sections into which the respective groups are subdivided.

The president and the two vice-presidents of each group jury will be nominated by his Imperial Highness the Archduke-President of the Imperial Commission.

The reporters of the group juries are elected by the members from their own number.

The group jury decides on the distribution of the work to be done by the sections which have not yet constituted themselves, on the propositions of the sectional juries, and proposes the award of the diplomas of honor.

XII.—The presidents' council.

The president, the vice-presidents, and the reporters of the group juries form the Council of Presidents.

The president and two vice-presidents of this council will be appointed by His Imperial Highness the Archduke-President of the Imperial Austrian Commission.

The Council of Presidents will decide on questions of principle which may be proposed by the group juries; they will decide on the propositions for awarding the diploma of honor, and will receive the final reports of the group juries, which are to be submitted to His Imperial Highness the Archduke-President of the Imperial Austrian Commission.

XIII.—Functions of the jury.

The president, or, in his absence, the vice-president, will convene the meetings, preside over the debates, control the correct entry by the secretary of the propositions and resolutions, as well as the reasons for the same in the "minute-book."

The minutes of the meetings, after having been verified, will be submitted to the General Manager.

XIV.—Decisions of the jury.

In order to pass a resolution, a quorum of at least half the number of all members, besides the chairman, president, or his deputy, must be present at each sectional or group jury, as also at the presidents' council.

The decisions of the jury must be passed by an absolute majority of votes; in case of an equal number of votes, the president or chairman has a casting vote.

XV.—Exclusion of the jurors and experts from the competition for prizes.

Exhibitors acting as members of the jury can in no case compete for awards. The same restriction applies to experts, but only for the section for which they are acting This exclusion may be marked on the goods exhibited.

The same rule applies also to the partners and managers of firms being exhibitors.

XVI.—Voluntary declination on the part of exhibitors to compete for prizes.

Every exhibitor is at liberty to withdraw his exhibits from the examination of the jury. This wish of the exhibitor must, however, be expressly stated on the question paper with the words "*Hors-concours*." Should the declaration not be made it will be presumed that he wishes his exhibits to be adjudicated upon.

With reference to objects which may be classed in different groups or sections, exhibitors are required to state on the question form in which group or section they wish to have them adjudicated upon.

XVII.—Awards for collective exhibitions.

As a rule, collective exhibitions will be judged in their entirety as one, and are, therefore, subject to the same regulations.

Should, however, any of the several exhibitors of such an exhibition desire to have his exhibits judged separately, he must supply the jury with the data required for that purpose.

XVIII.—Instructions preparatory to the proceedings of the jury.

Every exhibitor will receive from his commission a form of questions, which will give him an opportunity of supplying the jury with every information in respect to his exhibits.

It is in the exhibitor's own interest that this form should be filled up as completely and as fully as possible, and, above all, that it should be sent to the proper authorities in due time, lest he run the risk that his exhibits be not properly judged on account of insufficient information. The various commissions are requested to send in the question forms, duly filled up, to the General Manager at the very latest by the 1st May.

XIX.—Time allowed for the labors of the jury.

The International Jury will assemble on the 16th of June, 1873, and their proceedings must be finished by the end of July.

XX.—Publication of the jury awards.

The distinctions awarded to exhibitors will be made known in due form at a special public ceremonial on the 18th of August, 1873, and, after that date, they will be attached to the respective objects.

XXI.—Specification of awards.

The prizes awarded by the jury will consist of—

1. A diploma of honor of the Vienna Universal Exhibition of 1873.
2. A medal for progress.
3. A medal for merit.
4. A medal for fine arts.
5. A medal for good taste.
6. A medal for co-operators.
7. A diploma of merit, equivalent to "honorable mention."

An exhibitor is entitled to only one prize for his productions in any one branch of industry.

XXII.—Rules respecting the award of prizes.

In making the awards, the following principles will be observed:

(1.) The *diploma of honor of the Universal Exhibition of* 1873 *in Vienna*, is to be considered as a particular distinction for eminent merits in the domain of science, its application to the education of the people, and its conducement to the advancement of the intellectual, moral, and material welfare of man. This distinction can only be awarded by the presidents' council on the proposition of one of the group juries.

(2.) The *medal for progress** is for exhibitors in Groups I to XXIII, and in Group XXVI, who, compared with the productions exhibited at previous exhibitions, can prove noticeable progress in new inventions in the introduction of new materials and contrivances, &c.

(3.) The *medal for merit** will be awarded to exhibitors who can lay claim to excellence and perfection in material and workmanship, large extent of production, the opening of new markets, the employment of improved tools and machinery, and cheapness of produce.

(4.) The *medal for fine arts* is for distinguished art-productions exhibited in Group XXV.

(5.) The *medal for good taste** is for exhibitors of articles of industry the form and color of which constitute the characteristic features for adjudication.

(6.) The *medal for co-operators* is for such persons who, as managers of manufactories, foremen, designers of patterns, modellers, or as general assistants, are nominated on the part of the exhibitors on account of the leading part they have taken in the features of excellence of the productions, or in the increase of their sale.

(7.) The *diploma of merit*, or *honorable mention*, will be awarded to exhibitors who have given proof of meritorious accomplishments, but not in such a degree as to justify their title to either the medal for progress or for merit.

* At a meeting of the council of presidents, held before the awards were made, it was declared that the medals of progress, of merit, and of good taste were of equal value.—[Ed.]

XXIII.—Central office of the jury.

For the purpose of transacting the business, &c., of the jury as regards their constitution, deliberations, and proceedings, the delegates of the Director-General (Section VII) will form a bureau, which will collect and submit to them all documents intended for the members of the jury, send out the invitations for the jury meetings, inform the foreign commissioners and the exhibitors of the arranged examination of their exhibition objects by the jury, keep the minutes of the meetings, and carry on the whole correspondence, giving all manner of information, and procuring all assistance and appliances necessary for making the awards.

57. *Classification of exhibits.*—The classification of exhibits was officially given as follows:

GROUP I.—Mining, quarrying, and metallurgy.

Preliminary arrangement.

Mineral fuels, (coals, shales, and mineral oils.)
Mineral ores and metals.
Other minerals, (as salt, sulphur, graphite, &c.,) not including building-materials; *vide* group 18.
Natural alloys.
Drawings and models of objects relating to mining, metallurgy, and mineral industry, mining engineering, surveying, and map-making.
Geological works and geological maps, &c.
Tools and inventions for mining and metallurgy for underground and surface work.
Statistics of production.

Sections for the juries.

First section.—Mining.
Second section.—Iron-works.
Third section.—Other kinds of metallurgy.

GROUP II.—Agriculture, horticulture, and forestry.

Preliminary arrangement.

Plants for food and physic (excluding fresh fruits and vegetables, which are to be the subjects of temporary exhibitions.)
Tobacco and other narcotic plants.
Vegetable fiber, (as cotton, flax, hemp, jute, china-grass, &c.,) and other plants of commerce in their raw state.
Cocoons of silk-worms.
Animal products in a raw state, (skins, hides, feathers, bristles, &c.)
Wool.

Products of forestry, (timber, wood for cabinet-work, tanning substances, resin in a raw state, dyeing-woods, barks, charcoal-tinder.)
Peat and its products.
Manures.
Drawings and models of objects used in agriculture, horticulture, and forestry; farm-maps.
Works of the experimental stations, woodland and forest doom-books, statistics of forests, &c.
Processes and inventions for producing, transporting, and storing the above-mentioned products.
Plans of gardens, drawings, and models of horticultural implements, hot-houses, conservatories, irrigation, &c.
New methods of horticultural cultivation.
Statistics of production.

(*Vide* temporary exhibitions, No. 4.)

Sections for the juries.

First section.—Agriculture.
Second section.—Animal products.
Third section.—Forestry.
Fourth section.—Cultivation of the vine, fruit, vegetables, and horticulture.

GROUP III.—Chemical industry.

Preliminary arrangement.

Chemical products for technical and pharmaceutical purposes, (acids, salts, chemical preparations of all sorts.)
Raw substances and products of pharmacy, mineral waters, &c.
Fats and their products, (stearine, oil, acids, glycerine, soaps, candles, tapers, &c.)
Products of dry distillation, (as refined petroleum, slate-oil, paraffine, phenylic-acid, benzoine, aniline, &c.)
Ethereal oils and perfumeries.
Matches, &c.
Dye-stuffs, mineral and organic.
Resins, (washed, dyed, or bleached,) sealing-wax, varnish, albumen isinglass, glue, starches, dextrine, &c.
Contrivances and processes used in chemical production.
Statistics of production.

Sections for the jurics.

First section.—Chemical products for technical purposes.
Second section.—Pharmaceutical preparations, ethereal oils, perfumeries, drugs, and other raw products for pharmacy and chemical industry.

Third section.—Fat industry.
Fourth section.—Products of dry distillation.
Fifth section.—Explosive materials, dry-stuffs, varnishes, and other products of chemical industry.

GROUP IV.—SUBSTANCES OF FOOD AS PRODUCTS OF INDUSTRY.

Preliminary arrangement.

Flour and other farinaceous products, malt and its products.
Sugar and its products.
Spirits and spirituous liquors, &c.
Wines.
Ale, beer, porter, &c.
Vinegars.
Preserves and extracts, (extracts of meat, portable soups, condensed milk, preserved vegetables, preserved meat, &c.)
Tobacco and similar manufactures.
Confectionery, ginger-bread, chocolate, coffee-substitutes, &c.
Processes and inventions for preparing all these articles.
Statistics of production.

Sections for the juries.

First section.—Flour and other farinaceous products.
Second section.—Sugar, confectionery, and chocolate.
Third section.—Wine and its substitutes, beer and other fermented liquors, and vinegar.
Fourth section.—Preserves, extracts, and meats.
Fifth section.—Tobacco manufactures.

GROUP V.—TEXTILE INDUSTRY AND CLOTHING.

Preliminary arrangement.

Washed wool and hair used for textile fabrics, carded wool and worsted, combed wool and woolen fabrics, felt carpets, blankets, hair tissues mixed fabrics, including shawls.
Cotton, cotton substitutes, cotton thread, cotton fabrics, and cords.
Flax, hemp, jute, and other fibers, yarns, threads, and fabrics of the same, straw fabrics for bonnets, screens and mats, webs and cords of reed, cane, bass, hair, wire, &c.)
Raw silk, spun silk, and manufactures of silk, silk wastes.
Small-ware manufactures, gold and silver cloths and embroideries.
Lace.
Hosiery, milled and unmilled.
Finished objects of clothing, (clothes, gowns, hats, bonnets, shoes and boots, gloves, linen, &c.)

Upholstery, carpeting, curtains, bed-furniture, &c.
Artificial flowers and feather ornaments.
Processes and inventions used in the production of these manufactures.
Statistics of production.

Sections for the juries.

First section.—Woolen fabrics.
Second section.—Cotton fabrics.
Third section.—Linen fabrics.
Fourth section.—Silk fabrics.
Fifth section.—Fringe work, gold and silver webs, lace and loose woven fabrics, embroideries, ornamental feathers and artificial flowers made of various kinds of stuffs, paper, leather, &c.
Sixth section.—Linen, articles of clothing, fur, hats and bonnets, gloves.
Seventh section.—Shoe and boot makers' articles.
Eighth section.—Upholstery.

GROUP VI.—Leather and India-rubber industry.

Preliminary arrangement.

Leather, articles of leather, harness, saddles, trunks, and other leather goods, (excluding clothing and fancy goods,) parchment and gold-beater skin.
Skins and furs.
India-rubber and gutta-percha articles, (excluding philosophical and mechanical instruments and parts of machinery,) water-proof stuffs and cloths.
Processes and inventions used in the production of these manufactures.
Statistics of production.

Sections for the juries.

First section.—Leather and rough skins.
Second section.—Leather wares.
Third section.—India-rubber and gutta-percha wares.

GROUP VII.—Metal industry.

Preliminary arrangement.

Goldsmiths' and silversmiths' work and jewelry, &c.
Iron and steel wares, (excluding machinery, building-materials, philosophical and musical instruments.)
Manufactures from other metals and alloys.
Weapons of every description except military arms.
Processes and inventions used in the production of these manufactures.
Statistics of production.

Sections for the juries.

First section.—Gold and silver wares and jewelry.
Second section.—Iron and steel wares.
Third section.—Arms, with the exception of war armature.
Fourth section.—Other kinds of metal wares.

GROUP VIII.—Wood industry.

Preliminary arrangement.

Cabinet work, (inlaid floors, windows, doors, &c.)
Joiners' work.
Cleft wood-work, casks, shingles, sieves, &c.
Small staves and their products, matches, &c.
Veneers and marquetries.
Cut and turned wood.
Chisel work and carved work.
Cork manufactures.
Basket-work.
Wood-work, painted, stained, and gilt.
Processes and inventions used in the production of these manufactures.
Statistics of manufacture.

Sections for the juries.

First section.—Carpenters' and cabinet work, veneers, cut, turned, chisel and carved work.
Second section.—Productions of cleft wood-work, cork manufactures and wicker-work.
Third section.—Colored, painted, stained, and gilded wood-work.

GROUP IX.—Stone, earthenware, and glass industry.

Preliminary arrangement.

Stones, natural and artificial; slate and cement works, natural and imitated stones and marbles, paving-stones and floor-tiles, ornaments and decorations, pipes, grinding stones, &c.
Earthenware, pipes, cooking-vessels, stoves, plastic productions, terra cottas, &c.
Glass manufactures; glass for household use and fancy purposes, imitation gems and pearls, unset, &c.
Processes and manufactures used in the production of the above articles.
Statistics of production.

Sections for the juries.

First section.—Stone and cement wares.
Second section.—Earthenware.
Third section.—Glass wares.

GROUP X.—Small ware and fancy goods.

Preliminary arrangement.

Manufactures of ivory, meerschaum, tortoise-shell, mother-of-pearl, whalebone, wax wares, japanned goods, &c.
Fancy goods, of leather, bronze, &c.
Umbrellas, parasols, fans, canes, whips, &c.
Combs and brushes.
Toys.
Processes and inventions used in the production of these manufactures.
Statistics of production.

Sections for the juries.

First section.—Manufactures of meerschaum, tortoise-shell, horn, bone, ivory, mother-of-pearl, whalebone, &c.
Second section.—Toys and wax-works.
Third section.—Small ware and fancy goods of leather and bronze, lacquered work.
Fourth section.—Canes, whips, umbrellas, and parasols.

GROUP XI.—Paper industry and stationery.

Preliminary arrangement.

Paper-pulp, paper, and pasteboard.
Colored papers, paper-hangings, tapestry, playing-cards, &c.
Papier-maché goods, card, and mill-board.
Articles for writing, drawing, and painting.
Bookbinding and similar wook.
Processes and manufactures used in the production of the above manufactures.
Statistics of production.

Sections for the juries.

First section.—Paper wares, pasteboard, and paper.
Second section.—Colored paper, paper-hangings, playing-cards, cartoon-paper.
Third section.—Writing and drawing paper, and painters' requisites.
Fourth section.—Bookbinders', portfolio and papier maché goods.

GROUP XII.—Graphic arts and industrial drawing.

Preliminary arrangement.

Book printing.
Xylography.
Copper-plate and steel-plate printing.
Lithography and chromolithography.

Photography.
Engraving and guilloche work.
Pattern-drawing and drawing for decoration.
Tools and apparatus.
Statistics of production.

Sections for the juries.

First section.—Book, copper, steel-plate, and music printing; lithography, chromography.
Second section.—Engraving and guilloche work, xylography.
Third section.—Photography.
Fourth section.—Pattern-drawing and paintings for decoration.

GROUP XIII.—General machinery.

Preliminary arrangement.

Prime movers, (steam-generators, steam-engines, water-wheels, turbines, pressure-engines, air, wind, and electro-magnetic engines, gas-machines.
Machines for transmitting power, (shafts, wheels, pulleys, bands, &c.)
Machinery for working special kinds of materials, (machines for mining, metallurgy, metal-work, and wood-work; machines for spinning, weaving, knitting, sewing and embroidering; machines for fulling, cleansing, shearing, dyeing; machines for bleaching, leather-dressing, &c.; machines for paper manufactures and bookbinding, for type-founding, printing, lithographing, copper-plate printing, color printing, &c.; machines and apparatus for sugar-making, oil manufacture, breweries, distilleries, stearine, soap, candles, starch, ice-making, match-making, corn-mills, and agricultural machinery and apparatus.)
Other machinery not belonging to the above-mentioned, (blast-engines, fire-engines, pumps, ventilators, &c.)
Materials and parts of machinery.
Railway machinery, (locomotives, tenders, railway velocipedes and parts of them, railway carriages and parts composing them, special machinery and apparatus for railway workshops and railway contrivances; for making and maintaining railway plant; snow-plows, &c.)
Steam-gauges, dynamometers, tradiometers, &c.
All sorts of vehicles not concerned with rail.
Statistics of production.

Sections for the juries.

First section.—Prime movers, machines for transmitting power; parts of machinery.
Second section.—Machines for working special kinds of material, (with

the exception of agricultural machines, which are classified in Group II.)

Third section.—Means of transport and other plant for railways.

Fourth section.—Street locomotives, and other kinds of transport.

GROUP XIII*a*.—AGRICULTURAL MACHINERY.

GROUP XIV.—PHILOSOPHICAL, SURGICAL INSTRUMENTS.

Preliminary arrangement.

Mathematical, astronomical, physical, and chemical instruments, (instruments for measuring, weighing, and dividing, for optical purposes and electric telegraphy.)

Surgical instruments and apparatus, (artificial limbs, teeth, &c.)

Horological instruments, clocks, watches, and their parts, (chronoscopes, chronographs, electric clocks.)

Statistics of production.

Sections for the juries.

First section.—Mathematical, astronomical, and physical instruments; chemical apparatus.

Second section.—Clocks and watches.

Third section.—Surgical instruments.

GROUP XV.—MUSICAL INSTRUMENTS.

Preliminary arrangement.

Musical instruments.

Parts of them, (strings, bows, molding-boards, membranes, keys, pipes, &c.)

Sound-carrying apparatus, (speaking-pipes, signal-whistles, &c.)

Bells, chime of bells.

Statistics of production.

(*Vide* additional exhibition, No. 3.)

Sections for the juries.

First section.—Keyed instruments, (as pianos, organs, harmoniums.)

Second section.—Stringed instruments, (as harps, guitars, zithers.)

Third section.—Wind instruments, musical boxes, &c.

GROUP XVI.—THE ART OF WAR.

Preliminary arrangement.

Organization and recruiting of armies.

Equipment of troops, accouterments, and armor.

Artillery.

Military engineering.
Sanitary contrivances.
Military education, training, and instruction.
Cartography and historiography.

Sections for the juries.

First section.—Equipment of troops.
Second section.—General armament, artillery, and military engineering.
Third section.—Sanitary arrangements.
Fourth section.—Military education and instruction, cartography and historiography.

GROUP XVII.—The navy.

Preliminary arrangement.

Materials for naval architecture.
Models and drawings of boats and ships for inland lake and river navigation; sea-going ships, coasting-vessels, merchant-ships and ships of war, stores and fittings for equipment, outfit, and armament of ships.
Tools and apparatus used in ship-building.
Land and water works for navigation, (models and drawings of docks, harbors, sluices, floating-docks, floating-batteries, and coast-defences.)
Clothing, outfit, and accommodations for crews.
Hydrography, charts, meteorological instruments; education of seamen and officers.

Sections for the juries.

First section.—Naval architecture and equipment.
Second section.—Structures for navigations; hydrography.

GROUP XVIII.—Civil engineering, public works, and architecture.

Preliminary arrangement.

Building-materials; processes and apparatus for quarrying, brick-making; iron girder-work; preparation and preservation of wood; artificial stone, terra-cotta work, &c.
Materials and appliances for foundations, (pile-drivers, screw-piles, coffer-dams, caissons, pneumatic and diving apparatus.)
Contrivances and tools for earth-works, (excavators, dredging-machines, apparatus for raising, carrying, and transporting earth and materials.)
Materials and apparatus used for roads and railways, (road-rollers, railway superstructure, switches, crossings, turn-tables, traversing-tables, inclined planes, lifts; pneumatic and other modes of propelling; water-stations and their apparatus, railway-station buildings of all kinds, and systems of railway-signals).

Hydraulic engineering works, excluding sea-works, (river works, canal works, dikes, locks, dams, &c.)

Models and plans of viaducts, bridges, aqueducts, &c.

Plans, models, and drawings of public buildings, dwelling-houses, barracks, penitentiaries, prisons, and hospitals, schools and theaters, laborers' cottages; apparatus for lifting and moving heavy weights in buildings, as lifts, &c.; plans and models of cheap dwelling-houses; tools and implements of artisan builders.

Apparatus and inventions for health, comfort, and convenience in buildings, (for lighting, water-supply, drainage, water-closets, lightning conductors, &c.)

Agricultural engineering; plans for culture, fencing, draining; farm-buildings; buildings for cattle-breeding; stores, stables, manure-tanks, &c.

Industrial buildings; spinning-mills, weaving-mills, grinding-mills; distilleries, breweries, sugar-manufactories; warehouses, saw-mills, and docks, &c.

Sections for the juries.

First section.—Above-ground building.

Second section.—Hydraulic architecture.

Third section.—Making of roads and construction railways.

GROUP XIX.—THE PRIVATE DWELLING-HOUSE, ITS INNER ARRANGEMENT AND DECORATION.

Preliminary arrangement.

Models, drawings, and finished buildings representing dwelling-houses of civilized nations.

Drawings, models, and examples of thoroughly furnished apartments.

Sections for the juries.

The private dwelling-house.

GROUP XX.—THE FARM-HOUSE, ITS ARRANGEMENTS, FURNITURE, AND UTENSILS.

Preliminary arrangement.

Finished buildings, models, and drawings of farm-houses of the different nations of the world.

Drawings, models, and examples of peasant rooms, furnished and fitted out with their furniture and apparatus.

Sections for the juries.

The farm-house.

GROUP XXI.—National domestic industry.

Preliminary arrangement.

Pottery and porcelain.
Fabrics, tapestry, embroidery, lace, and other needlework.
Metal articles and ornaments.
Carved work and utensils.

Sections for the juries.

National domestic industry.

GROUP XXII.—Exhibition showing the organization and influence of museums of fine art as applied to industry.

Preliminary arrangement.

The various methods and means by which the different modern museums (viz, the South Kensington museum in London, and the similar museums in Vienna, Berlin, Moscow, &c.) endeavor to carry out the improvement of the general taste of the people, and the manner in which they promote the art, industry, and public instruction of their countries.
Exhibition of the objects which have been produced and propagated by these modern museums.

Sections for the juries.

Representation of the influence of museums on art-industry.

GROUP XXIII.—Art applied to religion.

Preliminary arrangement.

Decoration of churches, (wall-decoration, stained glass, glass painting, &c.)
Church-furniture, (altars, organs, pulpits, pews, shrines for inclosing sacred vessels, &c.)
Ornaments for altars, pulpits, crucifixes, chalices, liburiums, candlesticks, altar-hangings and carpets, pulpit-hangings, &c.
Objects used in baptism and funerals, &c.

Sections for the juries.

Ecclesiastical art.

Note I.—The objects exhibited in Groups XIX, XX, XXI, XXII, and XXIII will be judged by special juries formed of members of the juries of those groups to which the objects, considered from an industrial point of view, belong.

GROUP XXIV.—OBJECTS OF FINE ARTS OF THE PAST, EXHIBITED BY AMATEURS AND OWNERS OF COLLECTIONS, (EXPOSITION DES AMATEURS.)

Preliminary arrangement.

Paintings of ancient masters.

Objets d'art. Bronzes, enamels, miniatures, majolicas, porcelain, faïence, &c.

Sections for the juries.

Not subject to the cognizance of a jury.

GROUP XXV.—FINE ARTS OF THE PRESENT TIME, WORKS PRODUCED SINCE THE SECOND LONDON EXPOSITION OF 1862.

Preliminary arrangement.

Architecture, including models, designs, sketches, and surveys of architectural works of the present time.

Sculpture, including figures and groups of small sizes, engraving, medals, &c.

Paintings, including miniatures and enamels.

Graphic arts, including copper and steel engravings, etchings, wood-cuts, &c.

Sections for the juries.

First section.—Architecture.
Second section.—Sculpture.
Third section.—Painting.
Fourth section.—Drawing.

GROUP XXVI.—EDUCATION, TEACHING, AND INSTRUCTION.

Preliminary arrangement.

Education, exhibition of all the arrangements and contrivances for the better nursing, training, and rearing of children; their physical and mental development from the first days of their life up to school-time; their nourishment. Cradles, nurseries, &c.; child-gardens, (kindergarten,) child-games and amusements, child-gymnastics.

Teaching; exhibition of school-houses and school-apparatus in models, drawings, and examples; exhibition of means of instruction; the works and journals of instruction; description and illustrations of methods of instruction; history and statistics of a school, its organization and laws.

(1.) Elementary schools. This department will include apparatus for the instruction of the blind, deaf, dumb, and idiots.

(2.) Middle schools, comprehending gymnasiums, "realschulen," or schools wherein exact science and modern languages are taught.

(3.) Professional and technical colleges.

(4.) Universities.

Instruction in the more limited sense; instruction of adults through literature, the public press, public libraries, and educational societies, and associations for instruction.

All machinery is contained in group 13 but, nevertheless, the machines for working special kinds of material will be examined by the jury of the professional group to which they may belong, with the assistance also of competent machine-builders. It is left to the free-will of the exhibitor to choose the group in which he wishes his object to be placed, should it be susceptible of being placed in more than one group.

Sections for the juries.

First section.—Plans, organization, means of instruction, and performances of national schools.

Second section.—Middle-class schools.

Third section.—Technical colleges and universities.

Fourth section.—Auxiliary means for the improvement of adults.

ADDITIONAL EXHIBITIONS.

1. The history of inventions.
2. The history of industry.
3. Exhibition of musical instruments of Cremona.
4. Exhibition of the use of waste materials and their products.
5. The history of prices.
6. The representation of the commerce and trade of the world.

TEMPORARY EXHIBITIONS.

1. Live animals, (horses, cattle, sheep, pigs, dogs, fowls, game, fish, &c.)
2. Butcher's meat, venison, poultry, pork, &c.
3. Dairy-produce.
4. Garden-produce, (fresh fruits, fresh vegetables, flowers, plants, &c.)
5. Living plants injurious to agriculture and forestry.

58. *Administration.*—The administration of the Exhibition was entrusted to a commission constituted as follows:

PROTECTOR.

His Imperial Highness the Archduke Charles Lewis.

IMPERIAL COMMISSION.

President.

His Imperial Highness the Archduke Régnier.

Vice-Presidents.

His Grace the First Grand Steward of the Court of His Majesty Prince de Hohenlohe-Schillingsfürst.
His Excellency the Minister of the Imperial House and of Foreign Affairs, Julius Count Andrassy.
His Excellency the Imperial and Royal Ambassador in London, Ferdinand Count de Beust.
His Serene Highness Prince John de Liechtenstein.
His Grace Prince John Adolphus de Schwarzenberg.
His Excellency Count Alfred Potocki.

MEMBERS OF THE COMMISSION.

His Excellency the Great Chamberlain of His Majesty, Francis Count Folliot de Crenneville.
His Excellency the Grand Marshal of the Court of his Majesty, Count John de Larisch-Moennich.
His Excellency the Grand Equerry of his Majesty Count Charles de Grunne.
His Excellency the Minister of Finances of the Empire.
His Excellency the Minister of War of the Empire.
His Excellency the President of the Council of Ministers for the Kingdoms and States represented in Parliament.
His Excellency the Home Secretary.
His Excellency the Minister of Public Instruction.
His Excellency the Minister of Justice.
His Excellency the Cisleithanian Minister of Finances.
His Excellency the Minister of Commerce.
His Excellency the Manager of the Ministry for Agriculture.
His Excellency the Minister without portfolio.
The Chief of the Ministry for National Defense.
The Chief of the Naval Section of the War Department.
His Excellency the President of the Upper House of Parliament.
The President of the Lower House of Parliament.
His Excellency the President of the Imperial and Royal High Court of Justice.
The Marshal of the Province of Lower Austria.
The Governor of Lower Austria.
His Excellency the Commanding General in Vienna.
The President of the Crown Council of Law.
The Burgomaster and President of the Common Council of Vienna.
The Chief Commissioner of Police in Vienna.
The President of the Imperial and Royal Academy of Fine Arts of Vienna.
The President of the Imperial and Royal Academy of Science of Vienna.
The Director of the Imperial and Royal Picture-Gallery at the Belvedere.

The Director of the Imperial and Royal Geological Institute of the Empire.
The Director of the Imperial and Royal Central Institute for Meteorology.
The President of the Chamber of Commerce of the Archiduchy of Austria under the Enns.
The Director of the Imperial and Royal Military Geographical Institute.
The Director of the Imperial and Royal Museum of Fine Arts applied to Industry, (Paris 1867.)
His Excellency the Governor of the Imperial and Royal National Bank of Austria.
The President of the Central Statistical Commission.
The Rector of the Imperial and Royal University of Vienna.
The Rector of the Imperial and Royal Polytechnical School of Vienna.
The President of the Medical Society.
The President of the Association of Foresters.
The President of the Horticultural Society.
The President of the Geographical Society.
The President of the Corporation of Artists in Vienna.
The President of the Society of Arts and Manufactures in Vienna.
The President of the Society of Arts and Manufacturers in Sechshaus.
The President of the Society of Civil Engineers and Architects.
The President of the Imperial Agricultural Society in Vienna.
The President of the Musical Society.
The President of the Photographical Society.
The President of the Association of Authors, "Concordia."
The President of the Zoölogical and Botanical Society.
Dr. Joseph Arenstein, Proprietor of Estates, (Paris 1855, London 1862.*)
Baron August de Babo, Director of the School for the cultivation of Fruits and of the Vine at Klosterneuburg.
M. Emanuel Bachmayr, of the firm Leopold Bachmayr of Vienna.
M. Henry Alfred Barb, Imperial and Royal Aulic Counsellor, Director of the Oriental Academy.
Dr. Alexander Bauer, I. R. Professor at the Polytechnical School.
M. J. G. Beer, I. R. Counsellor, (London 1862, Paris 1867.)
Dr. Henry Billing de Gemmen, Member of the Common Council of Vienna.
M. Eugen Bontoux, General Manager of the Southern Railway, (Paris 1867.)
Dr. Hugh Brachelli, I. R. Professor at the Polytechnical School.
Chevalier William de Braumüller, Bookseller to the Court and University, (London 1862, Paris 1867.)
Count Arthur Bylandt-Rheidt, General and President of the technical and administrative military Committee.

* The appositions: "London 1851, 1862," "Paris 1855, 1867," point out that the respective persons have taken part in former International Exhibitions, as members of the Commission, or as jurors, delegues, reporters, exhibitors, &c.

Dr. Ernest Brücke, Imperial and Royal Aulic Counsellor and Professor at the University of Vienna.

The Baron Adam de Burg, Imperial and Royal Aulic Counsellor, former President of the Society of Arts and Manufactures in Vienna, (London 1851, 1862, Paris 1855 and 1867.)

The Chevalier Martin de Cassian, Manager of the Steam Navigation Company of the Danube.

M. Alois Czedik de Bründelsberg, Imperial and Royal Chief of Section D, and Director of the Academy of Commerce of Vienna.

M. Rudolph Ditmar, Manufacturer, (London 1862.)

The Baron Antony de Doblhoff-Dier, Proprietor of Estates, (Paris 1867.)

M. Charles Drachsler, Manufacturer, (Paris 1867.)

The Chevalier Henry de Drasche-Wartimberg, Proprietor of Estates, (London 1862, Paris 1867.)

M. Nicholas Dumba, Merchant.

The Baron Maurice Ebner de Eschenbach, General, Chief of the Engineer Corps of the Headquarters in Vienna, (London 1862, Paris 1867.)

The Chevalier de Eichler-Eichkron, Imperial and Royal Aulic Counsellor and General Inspector of the Northern Railway.

M. Conrad Frederick Ehrbar, Manufacturer, (London 1862, Paris 1867.)

The Chevalier William de Engerth, Imperial and Royal Aulic Counsellor and Deputy General Manager of the State Railway, (Paris 1855, 1867, London 1862.)

M. William F. Exner, I. R. Professor, (London 1862, Paris 1867.)

M. Maurice Faber, President of the Association of Brewers, (London 1862. Paris 1867.)

M. L. C. Falk, Director of the Spinning-Mill at Vöslau, (London 1851 1862, Paris 1855, 1867.)

M. Jacob Falke, Counsellor of the Government, Deputy Director of the Austrian Museum, (Paris 1867.)

The Chevalier Henry de Ferstel, Professor, (London 1862, Paris 1867.)

Dr. Adolphus Ficker, Imperial and Royal Counsellor at the Ministry of Public Instruction, (London 1862, Paris 1867.)

M. August Fölsch, Engineer.

M. Frederic Friedländer, Painter (Paris 1867.)

M. Maximilian Friedmann, Manufacturer and Member of the Common Council of Vienna.

The Baron Maximilian de Gagern, Imperial and Royal Aulic Counsellor at the Ministry of Foreign Affairs.

M. Charles Giani, Manufacturer, (London 1851, Paris 1867.)

M. Max Gomperz, Manufacturer.

M. Rudolph Grimus, Chevalier de Grimburg, I. R. Professor at the Polytechnical School, (London 1862.)

M. Joseph Gunkel, Tailor, (Paris 1855, London 1862.)

The Chevalier Edward de Haas, Manufacturer, (London 1851, 1862, Paris 1855, 1867.)

Dr. Edward Hanslik, I. R. Professor at the University, (London 1862, Paris 1867.)
M. Antony Harpke, Manufacturer, (London 1862, Paris 1867.)
M. George Hartl, Manufacturer, (Paris 1855, London 1862.)
M. Charles Hasenauer, Architect, (Paris 1867.)
Dr. Joseph Herr, I. R. Professor at the Polytechnical School.
M. Julius Hirsch, Author, (Paris 1867.)
M. Charles Hochstetter, Manufacturer, (London 1862, Paris 1867.)
His Excellency M. Leopold Frederic de Hofmann, Privy Counsellor and Chief of Section at the Ministry for Foreign Affairs.
The Chevalier Francis de Hopfen, President of the Credit Foncier in Vienna.
M. Otto Hornbostel, Manufacturer, (London 1851 and 1862, Paris 1855.)
The Chevalier Theodor de Hornbostel, Director of the Credit Mobilier in Vienna, (London 1851, Paris 1855.)
The Count Ernest de Hoyos-Sprinzenstein, Proprietor of Estates, (London 1862.)
Dr. Joseph Hyrtl, Aulic Counsellor and Professor at the University, (London 1862, Paris 1867.)
M. R. Isbary, Manufacturer, (London 1862, Paris 1867.)
M. Samuel Jägermayer, Merchant and Director of the First Austrian Savings-Bank, (Paris 1855.)
M. Charles Jenney, I. R. Professor at the Polytechnical School of Vienna.
M. William Jesse, Administrator of the Estates of His Imperial Highness the Archduke Albrecht, (London 1851, 1862, Paris 1855, 1867.)
The Chevalier Charles de Keissler, Manager of the Western Railway.
M. Albert Klein de Wiesenberg, Proprietor of Iron-Works, (London 1851, 1862, Paris 1855, 1867.)
M. August Klein, Manufacturer, (London 1862, Paris 1855, 1867.)
M. William Kraft, Manufacturer, (London 1862.)
Chevalier Alfred de Kremer, Imperial and Royal Aulic Counsellor.
The Baron Max de Kübeck, Proprietor of Estates.
M. August Küfferle, Manufacturer, (London 1862, Paris 1867.)
M. Ferdinand Lanfberger, Artiste Painter.
Chevalier Frederic de Leitenberger, Manufacturer, (London 1851 and 1862, Paris 1855 and 1867.)
The Baron John de Liebig, Manufacturer, (London 1851, 1862, Paris 1855, 1867.)
M. Lewis Lobmeyr, Manufacturer, (London 1862, Paris 1867.)
The Chevalier Maurice de Löhr, Counsellor at the Ministry of Interior, (London 1862.)
The Baron Arthur de Löwenthal, Member of the Common Council of Vienna, (London 1862.)
M. Charles Marzi, Merchant in Vienna.
The Chevalier Henry de Maurer, Proprietor of Estates, (London 1862, Paris 1867.)

Dr. Cajetan Baron Mayrau, Director of the Credit Mobilier in Vienna.
M. Achilles Melingo, Member of the Common Council of Vienna, (London 1862, Paris 1867.)
M. Francis Mayr, Chevalier de Melnhof, Proprietor of Estates, (London 1862, Paris 1867.)
M. Alexander de Nádosy, Imperial and Royal General and Chamberlain.
M. Joseph Neuwirth, Author.
M. Joseph Nikola, Member of the Common Council of Vienna.
M. William de Nördling, Aulic Counsellor at the Ministry of Commerce, (Railway Department,) (Paris 1867.)
M. Leopold C. Paffrath, Member of the Common Council of Vienna.
M. Charles Pfaff, Manufacturer.
His Excellency M. Ignace de Plener, Privy Counsellor, late Minister of Commerce and Finance.
M. Maurice Pollak, Manufacturer, Member of the Common Council of Vienna, (London 1862, Paris 1867.)
M. Lewis Possinger, Baron de Choborski, Chief of Section at the Ministry of Agriculture.
M. Franz de Raymond, Aulic Counsellor and Director of the Chancery of the Grand Stewardship of the Court.
M. John Ribarz, Banker, Deputy Governor of the National Bank.
The Chevalier Peter de Rittinger, Counsellor at the Ministry of Finance, (Paris 1867.)
M. Emil Rodek, Manufacturer and Merchant, (London 1862, Paris 1867.)
Chevalier Joseph de Romako, first Ship-building Engineer, Ship-building Inspector and President of Division in the Section for Marine at the Ministry of War of the Empire.
The Chevalier Frederic de Rosenberg, Manufacturer and Merchant, (London 1862.)
The Baron Anselm de Rothschild, Banker and Proprietor of Iron-Works, (London 1862, Paris 1855 and 1867.)
M. Robert Schlumberger, Proprietor of Estates, (London 1862, Paris 1867.)
M. H. D. Schmid, Manufacturer, (London, 1851 and 1862, Paris 1855 and 1867.)
M. Francis Schmitt, Manufacturer at Rechberg, (London 1851, 1862, Paris 1855, 1867.)
M. August Schneider, junior, Merchant, (Paris 1867.)
The Chevalier Anton Schrötter de Kristelli, Imperial and Royal Aulic Counsellor, Director of the Mint and General Secretary of the Academy of Science, (London 1851, 1862, Paris 1855, 1867.)
His Grace the Prince Adolph Joseph de Schwarzenberg, Proprietor of Estates, (London 1851, 1862, Paris 1855, 1867.)
M. Emil Seybel, Manufacturer, (Paris 1855, 1867, and London 1851, 1862.)
M. George Sigl, Manufacturer, (Paris 1867.)
Dr. Ferdinand Stamm, Proprietor of Mines, (London 1862, Paris 1867.)
M. Adolphus Strehblow, Manufacturer of leather goods.

The Chevalier Francis de Streicher, Imperial and Royal Aulic Counsellor, and Director of the Administration of the Estates of the Imperial and Royal Family.
M. Frederic Suess, Manufacturer, (London 1862, Paris 1867.)
M. Theodor Theyer, Merchant, (London 1862, Paris 1867.)
M. Edward Uhl, Member of the Common Council of Vienna.
M. Roman Uhl, Baker to the Court, (Paris 1867.)
The Chevalier Francis de Uchatius, Colonel of the Imperial and Royal Artillery.
M. Charles Vaugoin, Member of the Common Council.
The Baron Max Maria de Weber, Counsellor at the Ministry of Commerce, (Railway Department.)
Baron August de Wehli, Chief of Section at the Ministry of the Interior and Vice-President of the Commission for the Regulation of the Danube.
The Baron Francis de Wertheim, Manufacturer, (London 1851, 1862, Paris 1855, 1867.)
The Count Clement de Westphalen, Proprietor of Farms.
M. Gustave Wex, Aulic Counsellor and Chief of the Technical Office of the Commission for the Regulation of the Danube.
The Chevalier Otto de Wiedenfeld, Chief of Section at the Ministry of Commerce.
The Baron Maurice de Wodianer, Banker, (London 1862, Paris 1855, 1867.)
His Excellency Count Rudolph de Wrbna-Freudenthal, Proprietor of Estates, (Paris 1867.)
His Excellency the Count Edmund de Zichi, (Paris 1867.)
His Excellency the Count Henry de Zichi, (London 1862, Paris 1855, 1867.)
The Chevalier Charles de Zimmermann-Göllheim, (London 1862, Paris 1855, 1867.)
M. Victor Zimmermann, manufacturer, (London 1851, 1862, Paris 1855, 1867.)

GENERAL MANAGER.

His Excellency the Baron William de Schwarz-Senborn, Privy Counsellor of His Imperial and Royal Majesty, Deputy Consul-General in Paris, late Chief Commissioner of the Imperial and Royal Government at the Universal Exhibitions in London, 1851 and 1862, and Paris, 1855.

59. *The International Jury.*—The jury was selected by the administration from lists prepared by the several commissions, and consisted of representatives of all foreign nations exhibiting; the number of jurors allowed to each being determined by a scale based upon the number of exhibits, as indicated in the regulations already given.

The jurors were usually distinguished men of science, representatives of large manufacturing establishments, commissioners appointed by the

government, or delegates from states, or from important educational institutions.

The high character of this body is the best evidence of the care and discrimination with which awards were made. The jury-list as published in the Austrian official announcement was as follows:

INTERNATIONAL JURY.

COUNCIL OF PRESIDENTS.

PRESIDENT.

His Serene Highness Johann Adolph, Prince of Schwarzenberg, Arch-Duke of Kruman, Proprietor of Estates and Manufactories at Vienna.

VICE-PRESIDENTS.

His Excellency Jacob Thiery Borchard Anne Freiherr Heeckeren v. Berrerwaard, Ambassador Extraordinary and Plenipotentiary to His Majesty the King of Netherlands, at Vienna.

His Excellency Franz Adolph Baron Porto Seguro, Ambassador Extraordinary and Plenipotentiary to his Majesty the Emperor of Brazil at Vienna.

His Excellency Edward Count Piper, Ambassador Extraordinary and Plenipotentiary to his Majesty the King of Sweden and Norway at Vienna.

MEMBERS.

The presidents, vice-presidents, and reporters of group-juries. (See the lists of the several groups.)

GROUP-JURIES.

Group I.—Mining and Metallurgy.

PRESIDENT.

Froilius, C. O., General Director of State Railroads, President of the Iron Office, Stockholm, Sweden.

VICE-PRESIDENTS.

Krug, v. Nidda, Royal Director-in-chief of Mines, Berlin, Kingdom of Prussia, German Empire.

Tunner, Peter Ritter v., Royal and Imperial Counsellor of the Ministerial Department and Director of the Mining Academy, Leoben, Styria, Austria.

REPORTER.

Serlo, Dr., Royal Director of Mines, Breslau, Kingdom of Prussia, German Empire.

JURORS.

Abdullah, Bey, Professor at the Imperial School of Medicine, Constantinople, Turkey.

Akermann, Richard, Professor of Metallurgy at the Mining Academy at Stockholm, Sweden.

Axerio, Giulio, Royal Inspector of Mines, Milan, Italy.

Bonyouka, P., Major, Chief of Section, Royal Treasury, Inspector of Mines, Athens, Greece.

Cholostoff, P. v., Mining Engineer, Principal Agent of the Forges of Olnetz, Petrosawodsk, Russia.

Dietrich, Albert v., Proprietor of a Forge at Niederbronn, Alsace-Lorraine, German Empire.

Drasche, Ritter v., Wartinberg Heinrich, Proprietor of Mines, Vienna, Austria.

Eglestou, Thomas P., Professor in the School of Mines, Columbia College, New York, United States of North America.

Figueroa, Ramon Rua, Chief Engineer of Mines, Madrid, Spain.

Frey, C. August Edler v., General Director of the Iron-Founders' Association, Klagenfurt, Corinthia, Austria.

Gonzalez, Velasco Eduardo, formerly Major in the Artillery Corps, Madrid, Spain.

Gruner, Louis, General Inspector, Vice-President of the Board Superintending Mines, Paris, France.

Hammacher, Dr., Berlin, Kingdom of Prussia, German Empire.

Haswell, John, Director of the Construction of Machinery for the Austrian State Railroad Company, Vienna, Austria.

Haner, Franz Ritter v., Royal Imperial Aulic Counsellor and Director of the Geological Institution of the Empire, Vienna, Austria.

Hjortdahl, Th. H., Professor of Chemistry, Christiania, Norway.

Pellatti, Nicolo, Mining Engineer, Ancona, Italy.

Petitgand, E., Metallurgist, Paris, France.

Ramiz-Galvão, Benjamin Franklin, Dr., Rio de Janeiro, Brazil.

Richter, Dr., Professor at the Mining Academy at Freiberg, Kingdom of Saxony, German Empire.

Seefelder, L., Delegated Engineer from the Department of Public Works, Constantinople, Turkey.

Silva, Miguel Antonio da, Dr., Rio de Janeiro, Brazil.

Stölzel, C., Dr., Professor at the Royal Polytechnic High School, Munich, Kingdom of Bavaria, German Empire.

Stoll, Carl, Royal Hungarian Counsellor of Mines, Buda-Pesth, Hungary.

Trasenter, L., Member of the International Jury at the Exhibitions of London and Paris; Professor in the University at Lüttich, Belgium.

Tsigmondi Wilhelm v., Civil Engineer, Buda-Pesth, Hungary.

SUBSTITUTE.

Dallemagne Guillaume, (see Group VII,) Belgium.

GROUP II.—AGRICULTURE AND FORESTRY, HORTICULTURE, CULTURE OF THE VINE AND FRUIT TREES, AND AGRICULTURAL MACHINES.

PRESIDENT.

Potocki, Alfred Joseph Graf, His Excellency, Austria.

VICE-PRESIDENT.

Diwald, Adolph v., President of the Joint-Stock Company for the Management of Woods and Forests on the Frontiers, Buda-Pesth, Hungary.

REPORTERS.

Judrich, Dr., Royal High-Forester, Director of the Royal Academy of Foresty at Thoraud, Kingdom of Saxony, German Empire.

Wagner, Ladislaus v., Professor, Commissioner of Agriculture at the Exhibition, from Buda-Pesth, Hungary.

JURORS.

Ascárate, Casildo de, Agricultural Engineer, Madrid, Spain.

Aubry, Felix, Member of the Board of Trade of Paris, and of the International Juries of 1851, 1855, 1862, and 1867, France.

Aureliano, P. S., Director of the Central School of Agriculture of Roumania, Member of the Jury and Reporter, at the Paris International Exhibition, 1867, Bukarest, Roumania.

Baltazzi, Leon, Banker and Proprietor of Estates, Constantinople, Turkey.

Bech, A. W., Master of the Chase to the Prince, Denmark.

Bech, J. A., Counsellor of State at Taarnborg, Korsór, Denmark.

Birnbaum, Jacob, Buda-Pesth, Hungary.

Blaise, Adolphe, (des Vosges,) Proprietor of Vineyards, Paris, France.

Boutarel, Manufacturer and Member of the Central Commission for International Exhibitions, Paris, France.

Czilchert, Robert, Dr., Pressburg, Hungary.

Danhelofszky, Adolph, Private Forester of Praudau at Essegg, Croato-Slavonia, Hungary.

Delchevalerie, G., Director of the Horticultural School at Cairo, Egypt.

Domes, Albert, Forester, Weyer, Austria.

Dora, Constantin, Vienna, Austria.

Dürkheim, Montmartin Graf v., Alsace-Lorraine, German Empire.

Dutertre, Director of the Agricultural School at Grignon, France.

Eichmann, Bernard, Manufacturer of Machinery, Prague, Bohemia, Austria.

Foltz, Carl, Secretary of the Imperial and Royal Agricultural Society at Sinz, Austria.

Fuchs, J. M., Professor, Austria.

Garcia, Martinio Francisco, General Inspector of the Corps of Mining Engineers, Madrid, Spain.

Gyioko, Constantin v., Proprietor of Estates at Pressburg, Hungary.
Haberlandt, Friedrict Th. Dr., Professor in the Imperial and Royal Agricultural High School at Vienna, Austria.
Herdt, G., Dr., President of the Agricultural Society for the Grand Duchy Baden, Heidelberg, German Empire.
Kielmansegge, Carl Freiherr, v., Hainstetten, Austria.
Kraus, Friedrich, Counsellor of Agriculture at Vienna, Austria.
Lambl, Carl, Director of the Institution for the advancement of Agriculture and Forestry at Köros, (Krentz,) Croatia, Hungary.
Landolt, El., Professor at Zurich, Switzerland.
Lejeune, Phocas, Director of the Agricultural Public Institution at Gembloux, Belgium.
Leutritz, V. H., Proprietor of Manors in Deutschenbohra, Kingdom of Saxony, German Empire.
Michael, J., Colonel, India Office, London, Great Britain.
Micklitz, Robert, Royal and Imperial Chief Forester at Vienna, Austria.
Miraglia, Nicolo Cav., Director of the Agricultural Division of the Royal Italian Ministry for Agriculture, Industry, and Commerce, Rome, Italy.
Moll, Ed., Professor of Agriculture at the Conservatory for Arts, &c., Member of the International Jury, 1851, 1862, and 1867, Paris, France.
Müller, Adam, General Secretary of the General Committee of the Agricultural Society of Bavaria, Munich, German Empire.
Müller, Tobias, Bergen, Norway.
Nathorst, Hj., Professor, Director of the Academy of Agriculture at Alnarp, Sweden.
Navarro, Reverter Juan, Chief Engineer of Mines, Madrid, Spain.
Obermayer, Joseph, jr., Vienna, Austria.
Le Paute, —, Inspector of Forests, France.
Pichart-Berti, Carlo, Professor, Bologna, Italy.
Porlier, —, Vice-Director of Agriculture in the Ministry of Agriculture and Commerce, Paris, France.
Rau, L., Dr., Director of the Royal Academy of Agriculture, at Hohenheim, Kingdom of Würtemburg, German Empire.
Rincon, Manual, Ceferino, Proprietor of Estates and Agriculturist, Madrid, Spain.
Romaszkan, Jacob Freiherr v., Horodenka, Galizien, Austria.
Rothschild, Alphons Freiherr v., Member of the Central Commission for International Exhibitions, Paris, France.
Saldanha da Gama, José Cab. de. Rio Janeiro, Brazil.
Schallburg, Robert, Herzberg, Grand Duchy Mecklenburg, German Empire.
Schmirger, Johann, Professor of Agriculture and Forestry at Technical High School, Gratz, Styria, Austria.
Schütz, Cosmas, Klagenfurt, Corinthia, Austria.
Siemoni, G. Carlo, Cav., General Inspector of Forests at Florence, Italy.

Solski, N. V., Director of the Agricultural Museum at St. Petersburg, Russia.

Stebout, J., Professor at the Academy of Agriculture and Forestry at Petrowsk, near Moscow, Russia.

Terey, Paul, Proprietor of Estates at Buda-Pesth, Hungary.

Teston, Eugène, Member of the International Jury in 1867, Paris, France.

Thiel, H., Counsellor of Agricultural Economy, Berlin, Kingdom of Prussia, German Empire.

Tisserand, Eugène, General Inspector of Agriculture, Member of the International Juries of 1862 and 1867, Paris, France.

Tsuda, S., Commissioner of the Third Class, Japan.

Vizetelly, Henry, d. z. at Vienna, Great Britain.

Walker, Campbell, Captain, London, Great Britain.

Warder, J. A., Dr., Cincinnati, Ohio, United States of North America.

Wessely, Joseph, Royal Hungarian Commissioner for Forestry, Hungary.

Wilhelm, Gustav, Dr., Professor of Agriculture at the Technical High School of Gratz, Styria, Austria.

Witte, H., Hortulanus of the University at Leyden, Netherlands.

Yhleu, G. v., Superintendent of Fisheries, Sweden.

Zanelli, Antonio, Director of the Experimental Administration of Reggio Emilia, Italy.

SUBSTITUTES.

Saldanha da Gama, Luis Philippo de, Rio de Janeiro, Brazil.

Wessely, Johann, Director of Lands of the Count Keglevitch at Forna, Hungary.

EXPERTS.

——— Dinstl, Wilhelm, Vienna, Austria.

Sect. 2. Herzl, Alois, Vienna, Austria.

Sect. 2. Joachim, Friedrich, Vienna, Austria.

Sect. 1. Riedl, Franz, Imperial Counsellor at Vienna, Austria.

——— Santos, José Emilio de, (see Group IV,) Spain.

Sect. 5. Wichelhaus, Hermann, Berlin, Kingdom of Prussia, German Empire.

Group III.—Chemistry.

PRESIDENT.

Hofmann, A. W., Dr., Professor at the University at Berlin, Kingdom of Prussia, German Empire.

VICE-PRESIDENTS.

Wurtz, A., Member of the Institute, Dean of the Faculty of Medicine at Paris; Member of the Sanitary Council of France, and of the International Juries of 1855, 1862, and 1867, Paris, France.

Hlasiwetz, Heinrich, Dr., Royal and Imperial Aulic Counselor; Professor of Technical High School of Agriculture at Vienna, Austria.

REPORTER.

Fehling, v., Dr., Private Aulic Counselor; Professor of the Royal Polytechnic School at Stuttgart, Kingdom of Würtemberg, German Empire.

JURORS.

Beilstein, F., Professor at the Technological Institute at St. Petersburg, Russia.

Benzon, Alfred, Manufacturer at Copenhagen, Denmark.

Bergstrand, C. E., Professor of Agricultural Chemistry at the Royal College of Agriculture at Stockholm, Sweden.

Bonkowsky, Carl Effendi, Professor at the Imperial School of Medicine at Constantinople, Turkey.

Calvert, F. Crace, Manchester, Great Britain.

Candiani, Guiseppe, Manufacturer of Chemical Products at Milan, Italy.

Cannizzaro Stanislao, Professor of Chemistry at the Royal University at Rome, Italy.

Chandelon, J., Member of the Juries of previous Exhibitions of London and Paris, Professor in the University at Luttich, Belgium.

Chiris, Léon, Manufacturer; Member of the General Council of the *Departement des Alpes Maritimes*, Grasse, France.

Gastinel, Bey, Director of the Chemical Laboratory at Cairo, Egypt.

Hartl, Georg, Manufacturer at Vienna, Austria.

Hochstetter, Carl, Manufacturer of Chemical Products at Hruschau, Austria.

Hübner, B., Dr., Zeitz, Kingdom of Prussia, German Empire.

Hooslef, H. H., Dr., Christiania, Norway.

Kochmeister, Friedrich, President of the Chamber of Commerce and Trade at Buda-Pesth, Hungary.

Kopp, Emil, Professor at Zurich, Switzerland.

Kuhlmann, Fréderic, Member of the International Jury of Paris, 1867, Lille, France.

Kunheim, Private Counsellor of Commerce at Berlin, Kingdom of Prussia, German Empire.

Lamy, Auguste, Professor of Industrial Chemistry at the Central School at Paris, France.

Leon, José Gèl de, Colonel in the Army, Madrid, Spain.

Loebisch, W., Physician and Surgeon, Turkey.

Matscheko, Michael, Vienna, Austria.

Mosch, Carl, Manufacturer at Buda-Pesth, Hungary.

Muñoz de Luna, José Torres, Professor in the Central University at Madrid, Spain.

Navarro, Reverter Juan, (see Group II,) Spain.

Neudhvich, Carl v., Dr., Professor in the Royal Joseph Polytechnic at Buda-Pesth, Hungary.

Pizarro, João J., Dr., Rio de Janeiro, Brazil.

Roman Rodriguez, Cadiz, Spain.
Schrötter, Ritter v. Kristelli Anton, Dr., Royal and Imperial Ministerial Counsellor and Chief Director of the Mint at Vienna, Austria.
Serrurier, L., Amsterdam, Netherlands.
Seybel, Emil, Manufacturer, Liesing, near Vienna, Austria.
Smith, Lawrence J., Professor, Louisville, Kentucky, United States of North America.
Verson, Enrico Cav., Director of the Bachological Institute at Padua, Italy.
Wagner, Rudolph, Dr., Royal Aulic Counselor, Professor in the University at Würzburg, Kingdom of Bavaria, German Empire.
Wichelhaus, Hermann, Berlin, Kingdom of Prussia, German Empire.
Wunder, Gustav, Dr., Professor in the Superior Professional Schools at Chemnitz, Kingdom of Saxony, German Empire.

SUBSTITUTE.

Gérard, Anatole, President of the Chamber of Chemical Products at Paris, France.

EXPERTS.

Sect. 5. Ador, Emil, Dr., Geneva, Switzerland.
——— Fourcade, Member of the Chamber of Commerce at Paris, France.
Sect. 2. Jobst, Julius, Stuttgart, Kingdom of Würtemberg, German Empire.
Sect. 1. Priwoznik, Edward, Chemist to the Royal and Imperial Board of the Mint at Vienna, Austria.
Sect. 1. Seybel, Paul, jr., Vienna, Austria.

GROUP IV.—SUBSTANCES OF FOOD AS PRODUCTS OF INDUSTRY.

PRESIDENT.

Zichy, Heinrich Graf, His Excellency President of the Agricultural Union of the Oedenburg Committee, resident at Vienna, Hungary.

VICE-PRESIDENTS.

Wiener, Edward Ritter v. Welten, Royal Portuguese General Consul at Vienna, Portugal.
Carapebus, S. E., Baron v., Member of the Imperial Commission of Brazil, Rio de Janeiro, Brazil.

REPORTER.

Wiesner, Julius, Dr., O. Ö., Professor at the Royal and Imperial University at Vienna, Austria.

JURORS.

Alvares, dos Santos Luiz, Dr., Brazil.
Andréjeff, E., Member of the Council of Commerce and Manufactures at St. Petersburg, Russia.

Arnaud, Jeanti fils, France.
Bech, J. A., (see Group II,) Denmark.
Bertone di Sambuy, Ernesto Conte, Turin, Italy.
Bont, M. J. de, Amsterdam, Netherlands.
Boschierro, Giovanni, Piedmont, Alessandria, Italy.
Boucherot, Member of the Chamber of Commerce at Paris, France.
Caminhoá, Joaquim Monteiro, Dr., Rio de Janeiro, Brazil.
Carstanjen, Gustav, Sugar Manufacturer at Zinkendorf, Oedenburg Committee, Hungary.
Cesare, Raffaele de, Rome, Italy.
Curti, Constantin, Proprietor of Estates in Lower Austria, Greece.
† Cuvillier, Henri, Paris, France.
Doswald, J., Director of the Buda-Pesth Rolling-Mill Joint-Stock Company, Hungary.
Fayk, Bey, Professor at the Imperial Medical School at Constantinople, Turkey.
Flandorfer, Ignaz Ritter v., Oedenburg, Hungary.
Flesch, Isidor Vincenz, Brünn Mähren, Austria.
Frojo, Giuseppe, Professor at Naples, Italy.
Garcia, Sebastian, Barcelona, Spain.
Ganthy, Eugène, Director of the Royal Museum of Industry and Technological School at Brussels, Belgium.
Gerold, C. G. Berlin, Kingdom of Prussia, German Empire.
Gerstner, Anton, Vienna, Austria.
Greger, Max, London, Hungary.
Groult, Manufacturer at Paris, France.
Hassan, Effendi, Dr., Surgeon to the Egyptian Government, Cairo, Egypt.
Horsford, E. N., Professor at Harvard University, Boston, Mass., United States of North America.
Krückl, Joseph, Dr., Royal and Imperial Counsellor of Finance, and Inspector of Tobacco Factories, at Vienna, Austria.
Lade, Fritz, Proprietor of Estates at Geisenheim, Hessen-Nassau, Kingdom of Prussia, German Empire.
Leibenfrost, Franz, Wine Purveyor to the Imperial and Royal Court, Upper Döbling, near Vienna, Austria.
Lichtwitz, Emanuel, Manufacturer and Purveyor to the Imperial and Royal Court at Tropau, Silesia, Austria.
Mullé, Julius, Dr., Proprietor of Estates at Marburg, Styria, Austria.
Nessler, Julius, Dr., Professor and Director of the Agricultural Experimental Station at Carlsruhe, Grand-Duchy Baden, German Empire.
Odelberg, A., Manorial Proprietor, President of the Royal Agricultural Society at Stockholm, Sweden.
Orosi, Giuseppe, Professor, Italy.
Ott, Adolph, Berne, Switzerland.
Paget, Johann, Klausenburg Siebenbürgen, Hungary.

Perko, Franz, Marburg, Styria, Austria.
Quintana, Alberto, His Excellency, Barcelona, Spain.
Richter, Franz, Grinzing, near Vienna, Austria.
Robert, Julius, Sugar Manufacturer, Seelowitz, Mähren, Austria.
Rubio, Muñoz Pedro Julian, Agricultural Engineer at Madrid, Spain.
Salimbeni, Leonardo Conte, Modena, Italy.
Salomon, Alexander, Chemist of the Imperial Garden of Nikita in Crimea, Russia.
Santos, José Emilio de, His Excellency, Agricultural Counsellor and President of the Commercial Section of the General Commission at Madrid, Spain.
Schiefner, Bartha Julius, Secretary to the Royal Hungarian Exhibition Commissariate at Vienna, Austria.
Schlumberger, Robert, Vöslau, Austria.
Schmid, Franz, Mill-proprietor in Lower Lauzendorf, Austria.
Sestini, Fausto Cav., Director of the Agricultural Division at Rome, Italy.
Skene, August, Sugar Manufacturer, Vienna, Austria.
Sugden, Evans H., London, Great Britain.
Szirmay, Edmund v., Buda-Pesth, Hungary.
Tampier, Louis, General Consul for Turkey at Bordeaux, Turkey.
Targioni-Tozzetti, Adolfo Cav., Professor at the Museum of Natural History at Florence, Italy.
Teissonnière, Member of the Chamber of Commerce at Paris, and of the International Jury in 1867, Paris, France.
Thiel, Carl Eugen, Dr., Professor in the Polytechnic School at Darmstadt, Grand-duchy Hessen, German Empire.
Uhl, Roman, Baker to the Imperial and Royal Court at Vienna, Austria.
Valerio, Angelo, Manufacturer, Trieste, Austria.
Van den Wyngaert, Joseph J., Berlin, Kingdom of Prussia, German Empire.
Vecchi, Annibale, Rome, Italy.
Vizetelly, Henry, (see Group II,) Great Britain.
Warhanek, Carl, Manufacturer, Vienna, Austria.
Wegeler, Julius, Coblenz, Kingdom of Prussia, German Empire.
Wrede, J., Counsellor of Commerce at Berlin, Kingdom of Prussia, German Empire.
Zapata, Marco, Madrid, Spain.
Zichy, Franz Graf, His Excellency, Proprietor of Estates, Buda-Pesth, Hungary.
Zuckschwerdt, Chief of the Board of Trade at Magdeburg, Kingdom of Prussia, German Empire.

SUBSTITUTES.

Abeles, David, Buda-Pesth, Hungary.
Aubrey, Lecomte, Marine Commissioner, Member of the International Jury at Paris in 1867, Paris, France.

Barral, Louis, Substitute Juror of the International Jury at Paris in 1867, Paris, France.
Faro, Carlos Severo de, Rio de Janeiro, Brazil.
Landisi, Giuseppe, Bari, Italy.
Petrokokino, A., St. Petersburg, Russia.
Scaramanga, P., Russia.

EXPERTS.

Sect. 3. Faber, Richard, Purveyor to the Imperial and Royal Court at Vienna, Austria.
Sect. 3. Forster, Ferdinand, Vienna, Austria.
Sect. 3. Grossinger Emerich, Upper Döbling, near Vienna, Austria.
Sect. 3. Hasse, J., Zuaim, Mähren, Austria.
Sect. 3. Hanamann, Joseph, Physician to His Serene Highness the Prince of Schwarzenberg, Austria.
Sect. 3. Huber, Joseph, Counsellor of the Exchequer at Vienna, Austria.
Sect. 3. John Joseph, Perchtoldsdorf, Austria.
Sect. 3. Meichl, Theodor, Simmering, near Vienna, Austria.
Herr Moschinn, W., (see Group VI,) Russia.
Sect. 3. Noback, Gustav, Prague, Bohemia, Austria.
Sect. 3. Reisenleitner, J., Upper Döbling, near Vienna, Austria.
Sect. 3. Rosenthal, Hermann, Vienna, Austria.
Sect. 2. Rzehak, Carl, Vienna, Austria.
Sect. 3. Stiassny, Hermann, Commissioner of Assessments at Vienna, Austria.
Sect. 4. Walkhoff, J. H. G., Hamburg, German Empire.
Sect. 3. Wieninger, Joseph G., Vienna, Austria.

Group V.—Textile industry and clothing.

PRESIDENT.

Offermann, Carl Ritter v., Cloth Manufacturer at Brünn Mähren, Austria.

VICE-PRESIDENTS.

Desmet, Charles, President of the "*Circle industriel et commercial*" at Ghent, Belgium.
Liebermann, B., Private Counsellor of Commerce at Berlin, Kingdom of Prussia, German Empire.

REPORTER.

Schöller, Gustav Ritter v., Manufacturer at Brünn, Mähren, Austria.

JURORS.

Armand, E. G., Moscow, Russia.
Aubrey, Felix, (see Group II,) France.
Backé, Heinrich, Upholsterer to the Imperial and Royal Court at Vienna, Austria.

Bakay, Ferdinand, Master Rope-maker at Szeged, in Hungary.
Banmann, Zürrer, Zurich, Switzerland.
Bavier, Ernest de, Yokohama, China.
Bigelow, Lambert, Merchant at Worcester, Mass., United States of North America.
Bujatti, Franz, Silken Goods Manufacturer at Vienna, Austria.
Cantoni, Eugenio Barone, Imperial and Royal Austrian-Hungarian Consul, at Milan, Italy.
Carlhian, J., Member of the Chamber of Commerce at Paris, and of the International Juries at 1862 and 1867, France.
Chester, Haworth George, Manchester, Great Britain.
Christl, Joseph, Vienna, Austria.
Damböck, Ludwig, Lace Manufacturer at Vienna, Austria.
Dauphinot, S., President of the Chamber of Commerce, at Reims, France.
Demar, L., Member of the Chamber of Commerce, at Elbeuf, France.
Deutsch, S., Turkey.
Döhner, Arwed, Chemnitz, Kingdom of Saxony, German Empire.
Dooren, Ch. v., Manufacturer at Tilburg, Netherlands.
Dormitzer, Max Ritter v., Printed Goods Manufacturer, at Prague, Austria.
Drächsler, Carl, Lace Manufacturer to the Imperial and Royal Court at Vienna, Austria.
Fabra, Francisco Lopez, Provincial Commissioner at Barcelona, Spain.
Falk, Carl Ludwig, Vöslau, Austria.
Ferrero, Giuseppe, Secretary of the Chamber of Commerce of Turin, Italy.
Forster, Carl, jr., Augsburg, Kingdom of Bavaria, German Empire.
Ganahl, Carl, Manufacturer at Feldkirck, Vorarlberg, Austria.
Gerson, Louis, Manufacturer at Berlin, Kingdom of Prussia, German Empire.
Giani, Carl, Vienna, Austria.
Goldberger, de Buda J., Manufacturer at Alt-Hofen, Hungary.
Grandjean, L. A., President of the Board of Trade, at Verviers, Belgium.
Grön, L. J., Copenhagen, Denmark.
Gunkel, Joseph, sen., Master Tailor at Vienna, Austria.
Haas, Edward Ritter v., Manufacturer at Vienna, Austria.
Habig, Peter, Hatter to the Imperial and Royal Court at Vienna, Austria.
Harpke, Anton, Ribbon Manufacturer, at Vienna, Austria.
Heimendahl, Alexander, Counsellor of Commerce, Director of the Chamber of Commerce, at Crefeld, Kingdom of Prussia, German Empire.
Henneberg, Bruno, Pottendorf, Austria.
Hoffmann, C. J., Upholsterer to the Royal Hungarian Court at Buda-Pesth, Hungary.
Hornbostel, Otto, Silk Goods Manufacturer at Vienna, Austria.
Iljine, N., Professor in the Technological Institute at St. Petersburg, Russia.

Jägermayer, Samuel, Linen Furnisher to the Imperial and Royal Court at Vienna, Austria.

Kesselkaul, Robert, Cloth Manufacturer at Aix-la-Chapelle, Kingdom of Prussia, German Empire.

Kindtr, J., General Inspector of Industry at Brussels, Belgium.

Kiifferle, August, Linen Manufacturer at Freiwaldau, Silesia, Austria.

Lang, Edward, Manufacturer at Blaubeuren, Kingdom of Würtemberg, German Empire.

Leitenberger, Friedrich Freiherr v., Printed Goods Manufacturer at Cosmanos, Bohemia, Austria.

Lindheim, Alfred v., Director of the Austrian Bank of Commerce at Vienna, Hungary.

Lonvet, Eng., Paris, France.

Lundström, C. L., Gothenburg, Sweden.

Martini, Wilhelm, Frankfort-on-the-Main, Kingdom of Prussia, German Empire.

Marzi, Carl, Vienna, Austria.

Metz, Carl, Freiburg, Grand-Duchy Baden, German Empire.

Moxhet, Henri, Turkey.

Mullé, Julius, Dr., (see Group IV,) Austria.

Nessi, Giovanni Battista, Como, Italy.

Neumann, Franz, Master Furrier, Vienna, Austria.

Oberlithner, Edward Edler v., Manufacturer at Schonberg, Mähren, Austria.

Oliveira, Regis de Cab., Dr., Rio de Janeiro, Brazil.

Pastor, Godfried, Counselor of Commerce at Aix-la-Chapelle, Kingdom of Prussia, German Empire.

Pinchetti, Pietro, Como, Italy.

Raimann, Adolph, Manufacturer at Freiwaldau, Silesia, Austria.

Rath, Carl, Manufacturer at Buda-Pesth, Hungary.

Reckenschuss, Joseph Ritter v., President of the Chamber of Commerce and Trade at Vienna, Austria.

Regenhardt, Franz, President of the General Austrian Bank at Vienna, Austria.

Rondot, Natalis, Delegate of the Chamber of Commerce of Lyons, Member of the International Juries in 1851, 1855, and 1862, Paris, France.

Schwarz, Edward, Manufacturer at Mulhausen, Alsace-Lorraine, German Empire.

Sella, Giuseppe Venanzio Cav., Biello, Italy.

Seydoux, Charles, Member of the International Jury in 1867, Chateau Nord, France.

Siegmund, Franz, Manufacturer, Vienna, Austria.

Simons, Louis, Elberfeld, Kingdom of Prussia, German Empire.

Steiger, Meyer J., Herisau, Switzerland.

Stiasny, Maximilian, Glove Manufacturer, Vienna, Austria.

Sundt, Chr., Merchant and Bank Director at Bergen, Norway.

Wodianer, Moritz Freiherr v., Vienna, Austria.
Zachert, G., Baron, Manufacturer, Gour. Kowno, Russia.
Zechany, Peter, Pottendorf, in Lower Austria.
Zschille, Fedor, Counsellor of Commerce at Dresden, Kingdom of Saxony, German Empire.
Zuloaga, Guillermo, Madrid, Spain.

SUBSTITUTES.

Born, National Counsellor at Herzogenbuchsee, Bern, Switzerland.
Bucher, Alexander, National Counsellor at Burgdorf, Bern, Switzerland.
Duhayon, Felix, Member of the Board of Trade and Chamber of Commerce at Brussels, Delegate of the Belgian Commission, Belgium.
Garreschine, J., Manufacturer at Moscow, Russia.
Jeuffrain Paul, Manufacturer at Louviers, Eure, France.
Kleyber, H., Manufacturer at St. Petersburg, Russia.
Lisboa, Simões, Dr., Brazil.
Mattinzzi, Francesco, Milan, Italy.
Pinet, P., Manufacturer at Paris, France.
Schloesser, Heinrich W., Lodz, Russia.
Vatin, Emile, Manufacturer at Paris, France.

EXPERTS.

——— Casse, Manufacturer at Fives, near Lille, France.
Sect. 6. Flandorfer, Carl, Superintendent of a Manufactory at Hornsdorf, Mähren, Austria.
Sect. 7. Fränkl, Alfred, Vienna, Austria.
Sect. 2. Garber, Johann, jr., Manufacturer at Vienna, Austria.
Sect. 6. Gülcher, Theodor, Vienna, Austria.
Sect. 5. Haala, Carl, Manufacturer of Feathers and Artificial Flowers to the Imperial and Royal Court at Vienna, Austria.
Sect. 5. Hicke, Edward, Manufacturer of Feathers and Artificial Flowers at Vienna, Austria.
Sect. 6. Hörrig, Ignaz, Manufacturer at Vienna, Austria.
Sect. 6. Kreuzig, Anton, Vienna, Austria.
Sect. 7. Nessi, Luigi, Italy.
——— Pacher, Friedrich, Vienna, Austria.
Sect. 6. Schnek, Isidor, Rubber Manufacturer at Vienna, Austria.
Sect. 6. Trettera, Johann, Vienna, Austria.
Sect. 6. Wieninger, Franz, Vienna, Austria.

GROUP VI.—LEATHER AND CAOUTCHOUC INDUSTRY.

PRESIDENT.

Khodneff, A. v., Standing Secretary of the Imperial Economical Society at St. Petersburg, Russia.

VICE-PRESIDENTS.

Rieckh, Franz, Leather Manufacturer at Graz, Styria, Austria.
Henning, Hermann, Constantinople, Turkey.

REPORTER.

Kester, Edward, Superintendent of a Manufactory at Munich, Kingdom of Bavaria, German Empire.

JURORS.

Brinckmann, C., Copenhagen, Denmark.
Bulhôeo, Oscar Adolpho de, Dr., Rio de Janeiro, Brazil.
Daggett, J. C., Boston, Mass., United States of North America.
Deninger, Carl Franz, Counselor of Commerce at Mayence, Grand-Duchy Hessen, German Empire.
Fischer, Carl, Leather Manufacturer at Buda-Pesth, Hungary.
Gerhardus, Hermann, Leather Manufacturer at Vienna, Austria.
Katzwayer, Georg, Manufacturer at Vienna, Austria.
Lomer, Heinrich, Leipsig, Kingdom of Saxony, German Empire.
Mercier, E., Leather Manufacturer at Lausanne, Switzerland.
Moschinn, W., Member of the Muscovian Section of the Board of Trade and Manufactures, Russia.
Pavesi, Angelo, Professor of Chemistry at the Superior Agricultural School at Milan, Italy.
Reithoffer, Moritz, Rubber Manufacturer at Wimpassing, Austria.
Richardson, David, Elswick Leather Works, Newcastle-on-Tyne, Great Britain.
Ries, Alexander, Leather Manufacturer at Buda-Pesth, Hungary.
Soyer, Ch., Leather Manufacturer at Paris, France.
Verboeckhofen, E. B., Brussels, Belgium.

EXPERTS.

Sect. 2. Anderl, Ferdinand, Saddler to the Royal and Imperial Court at Vienna, Austria.
Sect. 2. Bode, Ferdinand, Master Saddler at Pressburg, Hungary.
Sect. 2. Foltz, Gottlieb, Saddler to the Imperial and Royal Court at Vienna, Austria.
Sect. 2. Otto, Carl, Master Saddler at Vienna, Austria.

GROUP VII.—METAL INDUSTRY.

PRESIDENT.

Dallemagne, Guillaume, Sclessin, near Lüttich, Belgium.

VICE-PRESIDENT.

Wertheim, Franz Freiherr v., President of the Lower Austrian Trade Union, Tool-Manufacturer at Vienna, Austria.

REPORTER.

Hardt, Friedrich Wilhelm, Hardware Manufacturer at Vienna, Austria.

JURORS.

Aegidi, Conrad, Jeweler to the Imperial and Royal Court at Vienna, Austria.

Backes, Georg Carl, Hanau, Kingdom of Prussia, German Empire.

Balbi, Senarega Giacomo Marchese, Secretary of the Royal Italian Legation at Vienna, Italy.

Birkner, Gustav, Director of Commerce at Nuremberg, Kingdom of Bavaria, German Empire.

Dorn, Carl, Dr., Tübingen, Kingdom of Würtemberg, German Empire.

Dreyfus, Gustave, Member of the Committee on the History of Labor at the Paris Exhibition, 1867, France.

Ebbinghaus, Hugo, Iserlohn, Province of Westphalia, Kingdom of Prussia, German Empire.

Ehin, G. E. O., Stuttgart, Kingdom of Würtemberg, German Empire.

Gastine, Renette, Manufacturer of Arms, at Paris, France.

Giacometti, G., Proprietor of Estates, Constantinople, Turkey.

Grothe, Dr., Professor in the Polytechnic School at Delft, Netherlands.

Halkier, P. A., Imperial and Royal Austrian-Hungarian Vice-Consul at Copenhagen, Denmark.

Hölder, Ewald, Pforzheim, Grand-Duchy Baden, German Empire.

Labsin, W., Assistant in the Technological Institute at St. Petersburg, Russia.

Langenfeld, Friedrich, Director of the Schlick Iron-Foundery at Buda-Pesth, Hungary.

Loog, F., German Empire.

Machanek, Oswald, Hardware Manufacturer at Olmütz, Mähren, Austria.

Matzenauer, Joseph, Jeweler to the Imperial and Royal Court at Vienna, Austria.

Mayer, Joseph, Jeweler to the Imperial and Royal Court at Vienna, Austria.

Neef, August, Director of the Chamber of Commerce at Solingen, Rhenish Province, Kingdom of Prussia, German Empire.

Paget, F. A., London, Great Britain.

Painter, Howard, Philadelphia, Pa., United States of North America.

Pastor, Arthur, Burtscheid, Kingdom of Prussia, German Empire.

Prohaska, Julius, Director of the Iron and Tin Manufacturers' Union, Austria.

Reuter, Richard, Manufacturer, Vienna, Austria.

Revilliod, Gustav, Geneva, Switzerland.

Rosthorn, Gustav Edler v., Hardware Manufacturer at Oed, Austria.

Rouvenat, S., Member of the Commission for International Exhibitions, Paris, France.

Russell, W., Dr., Vienna and Great Britain.
Schott, Edward, Director of Founderies at Ilsenburg am Harz, near Werningerode, Province of Saxony, Kingdom of Prussia, German Empire.
Schuehart, August, General Directer of the Innerberger Iron Company, Austria.
Vitaliano Rugero, Naples, Italy.
Waagner, Rudolph Philipp, Iron-Founder at Vienna, Austria.
Werndl, Joseph, General Directory of the Armory at Steyr, Austria.
Westman, E., Foundery-Engineer at Stockholm, Sweden.
Zuloaga, Eusebio, Chaser at Madrid, Spain.

SUBSTITUTE.

Dreifus, Gustav, Member of the Committee on the History of Labor at the Paris Exhibition, 1867, France.

EXPERTS.

———. Ador, Emil, Dr., (see Group III,) Switzerland.
Sect. 2. Böhm, Carl, Dr., Director of the Imperial and Royal Rudolph Hospital at Vienna, Austria.
Sect. 2. Deschauer, Anton, Commissioner of Assessments at Vienna, Austria.
Sect. 2. Gmelin, Otto, Dr., Engineer of the Imperial and Royal Priv.-Austrian State Railroad Company at Vienna, Austria.
Sect. 2. Heger, Ignaz, Professor at the Imperial and Royal Technical High School at Vienna, Austria.
Sect. 2. Röll, Friedrich Moritz, Dr., Counsellor of the Imperial and Royal Government and Director of the Imperial and Royal Veterinary Institute at Vienna, Austria.
Sect. 2. Stache, Friedrich Ritter v., Architect at Vienna, Austria.
Sect. 2. Stumpe, Reinhold, Mechanician at Vienna, Austria.

GROUP VIII.—WOOD INDUSTRY.

PRESIDENT.

Peterson, G., His Excellency, Imperial Private Counsellor of State, President of the Scientific Committee of the Domain, St. Petersburg, Russia.

VICE-PRESIDENTS.

Schestedt, Juul, Chamberlain at Funen, Denmark.
Bombelles, Marcus Graf, Proprietor of Estates at Warasdin, Croato-Slavonia, Hungary.

REPORTER.

Exner, Wilhelm, Dr., Counsellor to the Imperial and Royal Government, Professor in Imperial and Royal Academy of Forestry at Mariabrunn, Austria.

JURORS.

Almeida, Rufino de, Dr., Brazil.
Baiersdorf, Adolph, Vienna, Austria.
Brinkmann, Justus, Dr., Hamburg, German Empire.
Dasatiel, Joseph, Vienna, Austria.
De Metz, Ferdinand, Sculptor at Gröden, Austria.
Finocchietti, Demetrio Conte, Florence, Italy.
Gromann, Leopold, Varnish Manufacturer to the Imperial and Royal Court at Vienna, Austria.
Hirayana, S., Commissioner of Third Class, Japan.
Jenoure, Alfred, Kerr, Surrey, Great Britain.
Kölbl, Benedict, Gilder to the Imperial and Royal Court at Vienna, Austria.
Kramer, Samuel, Furniture Manufacturer to the Royal Hungarian Court at Buda-Pesth, Hungary.
Lowe, N. M., Boston, Mass., United States of North America.
Meltzer, F., Manufactory Director at St. Petersburg, Russia.
Mussini, Luigi Cav., Director of the Academy of Fine Arts at Sienna, Italy.
Peusens, F. C., Vienna, Austria.
Pfaff, Albert, Manufacturer at Berlin, Kingdom of Prussia, German Empire.
Pfeifer, Joseph, Proprietor of Estates in Croatia, Resident at Vienna, Hungary.
Fössenbacher, Anton, Munich, Kingdom of Bavaria, German Empire.
Rossigneux, Charles, Architect, Member of the International Jury at London, 1862, Paris, France.
Royle, J. R., India Museum, at London, Great Britain.
Salvisberg, F., Builder, of the Canton Bern, Switzerland.
Schmidt, Philipp, Cabinet-maker to the Imperial and Royal Court at Vienna, Austria.
Shioda, Commissioner of First Class, Japan.
Tasson, Joseph, fils, Member of the Belgian Commission for the Vienna Exhibition, Belgium.
Thonet, Joseph, Manufacturer at Vienna, Austria.
Togoresy, Fabrégnas Joaquin, Engineer and Marine Contractor, Madrid, Spain.
Westerberg, J. A., Architect at Gothenburg, Sweden.
Zuloaga, Eusebio, (see Group VII,) Spain.

SUBSTITUTES.

Penna, Ferreira Carlos, Dr., Rio de Janeiro, Brazil.
Savelieff, Counselor of State, Russia.

EXPERT.

Sect. 2. Murnik Johsun, Secretary of the Chamber of Commerce at Laibach, Austria.

Group IX.—Industry of stone, clay, and glass ware.

PRESIDENT.

Guillaume, M., Member of the Institute and of the Central Commission for International Exhibitions, Director of the School of Fine Arts, and Member of the Council for the Improvement of the National Industry at Sevres, France.

VICE-PRESIDENTS.

Lobmeyr, Ludwig, Glass-dealer to the Imperial and Royal Court at Vienna, Austria.

Mondron, Léon, Lodelinsart, Belgium.

REPORTER.

Schmidt, Edward, Dr., Civil Engineer at Vienna, Austria.

JURORS.

Archer, C., Professor at the Museum for Science and Art at Edinburgh, Great Britain.

Arx, B. v., National Counselor at Olten, Solothurn, Switzerland.

Cohausen, C. v., Colonel a. D., Conservator of the Museum at Wiesbaden, Kingdom of Prussia, German Empire.

Girard, Aimé, Professor at the National Conservatory of Arts, &c., Member of the International Jury at Paris, 1867, France.

Hinton, Louis J., Manufacturer at Ithaca, N. Y., United States of North America.

Krause, Franz, Glassware Manufacturer at Steinschönau, Bohemia, Austria.

Kroupski, Alexander, Assistant at the Technological Institute at Saint Petersburg, Russia.

Lambert, G., Professor and Mining Engineer at Brussels, Belgium.

Luynes, V. de, Professor at the National Conservatory of Arts, &c., at Paris, France.

March, Paul, Counsellor of Commerce at Charlottenburg, near Berlin, Kingdom of Prussia, German Empire.

Mieg, Ludwig, Porcelain Manufacturer at Pirkenhammer, Bohemia, Austria.

Muysken, C., Architect and Secretary of the Royal Netherlands Commission, Netherlands.

Nôtome, K., Commissioner of Third Class, Japan.

Ogata, K., Commissioner of Third Class, Japan.

Poschinger, Georg. Benedict v., Proprietor of Estates and Manufactories at Frauenau, near Zwiesel, Kingdom of Bavaria, German Empire.

Richard, Giulio, Clayware Manufacturer at Milan, Italy.

Saupere y Miguel Salvador, Architect at Barcelona, Spain.

Schon, Philipp, Manufacturer at Copenhagen, Denmark.
Szumrâk, Ernest, Buda-Pesth, Hungary.
Teirich, Emil, Dr., Engineer and General Secretary of the Wienerberger Brick Manufacturing Company, Vienna, Austria.
Terenzio, Tony, former Director of Imperial Antiquary Museum at Constantinople, Turkey.
Pestore, Giaomo, Engineer at Rome, Italy.
Zuloaga, Guillermo, (see Group V,) Spain.

SUBSTITUTE.

Wolf, Heinrich, Imperial and Royal Mining Counsellor at Vienna, Austria.

EXPERTS.

Sect. 1. Axerio, Giulio, (see Group I,) Italy.
Sect. 1. Bartelo, Heinrich, Berlin, German Empire.
Sect. 1. Finochietti, Demetrio Conti, (see Group VIII.)
Sect. 1. Neumüller, Joseph, Vienna, Austria.
Sect. 1. Roger, George, La Ferté sous Jouarre, France.
Sect. 1. Schmid, Franz, (see Group IV,) Austria.
Sect. 1. Tasson, Joseph, fils, (see Group VIII,) Belgium.
Sect. 1. Van den Wyngaert, Joseph J., (see Group IV,) German Empire.

Group X.—Hardware industry.

PRESIDENT.

Steinbeis v., His Excellency, Dr., President of the Royal Würtemberg, Central School of Commerce and Trade at Stuttgart, German Empire.

VICE-PRESIDENT.

Bertone di Sambuy, Manfedo Cav., Turin, Italy.
Rosenberg, Friedrich Ritter v., Vienna, Austria.

REPORTERS.

Seufft, Chief Inspector of the Royal Place of Review at Stuttgart, Kingdom of Würtemberg, German Empire.

JURORS.

Duvelleroy, Member of the International Jury, 1867, Paris, France.
Edouard Bey, Secretary of the Ministry of Public Works, Turkey.
Eichmüller, Artist at Copenhagen, Denmark.
Hanusch, Alois, Bronze-ware Manufacturer to the Imperial and Royal Court at Vienna, Austria.
Kiefer, G., Basle, Switzerland.
Klien, August, Manufacturer of Trinkets and Je welry to the Imperial and Royal Court at Vienna, Austria.

Ludewig, Albert, Vienna, Austria.
Mayer, Alois, Turnery-ware Manufacturer, Vienna, Austria.
Meidinger, Heinrich, Dr., Professor, Carlsruhe, Grand-Duchy Baden, German Empire.
Millet, Frank D., Cambridge, Mass., United States of North America.
Mönch, Julius, Counsellor of Commerce at Offenbach, Grand-Duchy Hessen, German Empire.
Mounsey, A. H., Vienna and Great Britain.
Reimann, G. H., Austria.
Söhlke, G., Berlin, Kingdom of Prussia, German Empire.
Strehblow, Adolph, Leather Fancy Goods Manufacturer at Vienna, Austria.
Szvetenay, Nicolaus v., Dr., Secretary of the Chamber of Commerce at Buda-Pesth, Hungary.
Ullmann, Siegfried, Fürth, Kingdom of Bavaria, German Empire.
Zamboni, Giovanni Cav., Florence, Italy.

Group XI.—Paper industry.

PRESIDENT.

Manner, Jacob Ritter v., Manufacturer at Vienna, Austria.

VICE-PRESIDENTS.

Tanaka, J., Commissioner of First Class, Japan.
Tets, Arnold van, Secretary of the Royal Legation, Netherlands.

REPORTER.

Lieck, Franz, Manufacturer at Berlin, Kingdom of Prussia, German Empire.

JURORS.

Bécoulet, Ch., President of the Paper Manufacturers' Union at Paris, France.
Falcan Effendi, General Consul of Turkey, Chief Secretary of the Embassy at Vienna.
Ferrigni, Pietro, Florence, Italy.
Guyot, Eugène, Brussels, Belgium.
Lewenhaupt, St. Graf, Manufacturer at Malmö, Sweden.
Meynier, C., Paper Manufacturer at Fiume, Hungary.
Orth, Moritz v., Paper Manufacturer at Maschendorf, Bohemia, Austria.
Portal, Whyndham S., Malshanger, Basingstoke, Great Britain.
Salazar, Pedro Gutierrez, Dr., Madrid, Spain.
Theyer, Theodor, Vienna, Austria.
Völter, Heinrich, Heidenheim, Kingdom of Würtemberg, German Empire.
Yamasaki, N., Commissioner of Second Class, Japan.
Zimmermann, Victor, Manufacturer of Paper Hangings to the Imperial and Royal Court at Vienna, Austria.

SUBSTITUTES.

Bettelheim, Wilhelm, Arad, Hungary.
Brewer, E., New York, N. Y., United States of North America.
Frenkell, F. de, Manufacturer in Finnland, Russia.

EXPERTS.

Sect. 2. Girard, Aimé, (see Group IX,) France.
Sects. 3 and 4. Mönch, Julius, (see Group X,) German Empire.
Sect. 4. Strehblow, Adolph, (see Group X,) Austria.
Sects. 3 and 4. Ullmann, Siegfried, (see Group X,) German Empire.

GROUP XII.—GRAPHIC ARTS AND PROFESSIONAL DRAWING.

PRESIDENT.

Buchanan, Andrew, His Excellency, Royal Great Britannic Ambassador at Vienna, Great Britain.

VICE-PRESIDENTS.

Wolowski, Louis, Dr., Member of the Institute and of the Central Commission for International Exhibitions, Professor at the Conservatory for Arts, &c., Member of the International Juries of 1851, 1855, 1862, and 1867, Paris, France.
Melingo, Achilles v., Trustee of the Imperial and Royal Museum of Art and Industry at Vienna, Austria.

REPORTER.

Vogel, L., Professor at the Royal Technological Institute at Berlin, Kingdom of Prussia, German Empire.

JURORS.

Abrahams, C., Architect at Copenhagen, Denmark.
Chomel, Francis, Geneva, Switzerland.
Davanne, Alphonse, President of the Photographic Company and Member of the International Jury, 1867, at Paris, France.
Engel, Wilhelm, Printer and Lithographer at Vienna, Austria.
Falk, Sigmund, Director of the Printers' Joint Stock Company at Buda-Pesth, Hungary.
Gerold, Frederich, Imperial Counsellor at Vienna, Austria.
Guyot, Eugène, (see Group XI,) Belgium.
Laufberger, Ferdinand, Professor at the School of Fine Arts of the Imperial and Royal Museum of Art and Industry at Vienna, Austria.
Lerritzky, S. v., St. Petersburg, Russia.
Lorck, Carl, Consul at Leipzig, Kingdom of Saxony, German Empire.
Luckhardt, Frederick, Photographer of the Imperial and Royal Court at Vienna, Austria.

Marne, Alfred, Member of the Central Commission for International Exhibitions, Tours, France.
Masson, G., Printer, at Paris, France.
Mitchell, Muirhead H. M., Inspector of Schools at London, Great Britain.
Montiroli, Giovanni, Cav., Rome, Italy.
Pavan, Antonio, Cav., Florence, Italy.
Poorter, B. de, Director and Professor at the Imperial Academy of Plastic Arts at Amsterdam, Netherlands.
Ramiz-Galvão, Benjamin Franklin, Dr., (see Group I,) Brazil.
Rödel, Georg, Professor of Technical Drawing at the Superior School at Brünn, Mähren, Austria.
Silcox, George W., New York., N. Y., United States of North America.
Tubino, Francisco Maria, Writer, at Madrid, Spain.

Group XIII.—General and agricultural machinery.

PRESIDENT.

Engerth, Wilhelm Ritter v., Counselor of the Imperial and Royal Court, and Substitute for the General Director of the Imperial and Royal Private Austrian State Railroad Company, Vienna, Austria.

VICE-PRESIDENTS.

Karmarsch, Carl, Dr., Private Counsellor of the Government and Director at the Polytechnic School at Hanover, Kingdom of Prussia, German Empire.
Anderson, Dr. J., Machinery Department at Woolwich, Great Britain.

REPORTER.

Grimus, Ritter v., Grimburg, Rudolph, Professor at the Imperial and Royal High School at Vienna, Austria.

JURORS.

Angström, C. A., Professor at the Royal Polytechnic Institute at Stockholm, Sweden.
Belpaire, General Inspector of the Administration of Railroads, Stations of Telegraphs at Brussels, Belgium.
Bertone di Sambuy, Ernesto Conte, (see Group IV,) Italy.
Böttcher, Counselor of the Government, Director of the Superior Technical School at Chemnitz, Kingdom of Saxony, German Empire.
Colombo Giuseppe, Cav., Professor at Milan, Italy.
Delabar, G., Professor at St. Gallen, Switzerland.
Diefenbach, Julius, Counselor of the Royal Government at Stuttgart, German Empire.
Ehrler, Wagon Manufacturer at Paris, France.

Eichleiter, Anton, Vice-President of the Ganz Iron Founding and Engine Manufacturing Joint-Stock Company at Buda-Pesth, Hungary.

Hartig, E. Dr., Professor at the Royal Polytechnic School at Dresden, Kingdom of Saxony, German Empire.

Hermann, Gustav, Professor at the Royal Polytechnic School at Aix-la-Chapelle, Kingdom of Prussia, German Empire.

Holmes, George C. V., London, Great Britain.

Holmes, Joseph E., New York, United States of North America.

Howard, Elphinstone, London, Great Britain.

Jenny, Carl, Imperial and Royal Mining Counsellor, and Professor at the Technical High School at Vienna, Austria.

Kessler, v., Director of the Machine-Shop at Esslingen, Kingdom of Würtenberg, German Empire.

Kick, Friedrich, Professor at the German Polytechnic Institute at Prague, Austria.

Linnemann, Johann, Captain, Denmark.

Lohner, Jacob, Wagon Manufacturer at Vienna, Austria.

Padula, Fortunato, Director of the Engineering School at Naples, and Professor of Engineering, Italy.

Pekar, Emerich, Director of the Debreczin Steam-Mill Joint-Stock Company, Hungary.

Pfaff, Carl, Engine Manufacturer at Ottakring, near Vienna, Austria.

Reuleaux, Franz, Private Counselor of the Government, Director of the Royal Technical Academy at Berlin, Kingdom of Prussia, German Empire.

Schneider, Henri, Creuzot, France.

Siemens, William C., Westminster, London, Great Britain.

Thurston, R. H., Professor of Mechanical Engineering at the Stevens Institute of Technology, Hoboken, New Jersey, United States of North America.

Tresca, H., Member of the Institute, Vice-Director of the Conservatory of Arts, &c., Member of the International Juries of 1855, 1862, and 1867, Paris, France.

Verderber, Stephan, Chief Engineer of the Royal Hungarian Communications, Ministry at Buda-Pesth, Hungary.

Wischnegradski, J., Professor at the Technological Institute at St. Petersburg, Russia.

Wöhler, A., Director of the North-German Joint-Stock Company for Railroad Expenses, Berlin, Kingdom of Prussia, German Empire.

SUBSTITUTE.

Beco, J., Engineer at Vienna, Austria.

EXPERT.

Sect. 2. Siemens, Carl., Professor at Hohenheim, Kingdom of Würtemberg, German Empire.

Group XIV.—Philosophical and surgical instruments.

PRESIDENT.

Wartmann, Elie, Professor at Geneva, Switzerland.

VICE-PRESIDENTS.

Siemens, Werner, Dr., Berlin, Kingdom of Prussia, German Empire.
Herr, Joseph, Dr., Imperial and Royal Ministerial Counsellor, and Director of the Normal Gauging Commission at Vienna, Austria.

REPORTER.

Hirsch, Adolph, Dr., Neuenburg, Switzerland.

JURORS.

Aguilar y Vela Antonio, His Excellency, Director of the Astronomical and Meteorological Observatory at Madrid, Spain.
Bock, J. C. A., State Counsellor and Professor at Copenhagen, Denmark.
Bréguet, Mechanician and Constructor of Telegraph Apparatus at Paris, France.
Brooke, Charles, London, Great Britain.
Frick, J., Dr., Chief Counsellor of Schools at Carlsruhe, Grand-Duchy of Baden, German Empire.
Govi, Gilberto Cav., Professor at Rome, Italy, Jolly, V., Professor in the University at Munich, Kingdom of Bavaria, German Empire.
Kraft, Wilhelm, Manufacturer of Mathematical and Philosophical Instruments at Vienna, Austria.
Lambert, G., Belgium.
Le Roux, J. P., Professor of Geometry at the Conservatory of Arts, &c., at Paris, France.
Lines, Robert B., Washington, D. C., United States of North America.
Listing, J. B., Dr., Professor in the University at Göttingen, Kingdom of Prussia, German Empire.
Marenzeller, Ignaz, Watchmaker at Vienna, Austria.
Mosetig-Moorhof, Albert Ritter v., Physician and Surgeon, Austria.
Onimus, Dr., of the Faculty at Paris, France.
Riemsdyk, A. D., v., Dr., Member of the College of Numismatics at Utrecht, Netherlands.
Thanhöffer, Ludwig, Professor at the Royal Veterinary Institute at Buda-Pesth, Hungary.

SUBSTITUTE.

Lattes, Oreste, Engineer at Turin, Italy.

Group XV.—Musical Instruments.

PRESIDENT.

Petrella, Enrico, Naples, Italy.

VICE-PRESIDENTS.

Dumba, Nicolaus, Vienna, Austria.
Lissajous, J., Professor of Physics at Paris, France.

REPORTER.

Hauslick, Edward, Dr., Professor at the Imperial and Royal University at Vienna, Austria.

JURORS.

Bevau, Philipp, London, Great Britain.
Castrone-Marchesi, Salvatore, Cav. de, Italy.
Cerveny, V. F., Manufacturer at Königgratz, Bohemia, Austria.
Fuertes, Mariano Soriano, Compositor at Madrid, Spain.
Gallay, Jules, Author of Works on Ancient and Modern Musical Instruments at Paris, France.
Herzfeld, Joseph, Local Commissioner of the Royal Hungarian Exhibition Commission at Vienna, Hungary.
La Roche, H., Professor in the Conservatory at St. Petersburg, Russia.
Paul, Oscar, Dr., Professor at the University at Leipzig, Kingdom of Saxony, German Empire.
Schiedmayer, Julius, Stuttgart, Kingdom of Würtemberg, German Empire.
Weber, Johann, Musical Director at Bern, Switzerland.

EXPERT.

Sect. 1. Ehrbar, Friedrich, Imperial and Royal Court, Piano Manufacturer at Vienna, Austria.

Group XVI.—The art of war.

PRESIDENT.

Bylandt-Rheidt, Arthur Graf, Royal and Imperial General-Major, President of the Technical Administrative Military Committee at Vienna, Austria.

VICE-PRESIDENTS.

Kittary, President of the Technical Committee on Military Intendancies at St. Petersburg, Russia.
Grimsgaard, Chr. S., Colonel and Chief of the Royal General Staff, Christiania, Norway.

REPORTER.

Regely, M., Lieutenant-Colonel at Berlin, Kingdom of Prussia, German Empire.

JURORS.

Carette, Lüttich, Belgium.
Ebner, v., Eschenbach Moritz Freiherr, Imperial and Royal General Major at Vienna, Austria.

Ghiczy, Béla v., Royal Hungarian Honvéd-Colonel at Buda-Pesth, Hungary.
Lambert, (see Group XIV,) Belgium.
Leon, José Gil de, (see Group III,) Spain.
Goodenough, L. C., Lieutenant-Colonel, assigned by the British Embassy at Vienna, Great Britain.
Herzog, Hans, General at Aarau, Switzerland.
Meigs, J. V., Lowell, Mass., United States of North America.
Mertian, George, Captain of the Artillery, France.
Palmstjerna, M. A. Hj. Freiherr v., Captain of the Artillery, Adjutant to His Majesty the King, Stockholm, Sweden.
Pozzolini, Giorgio Cav., Lieutenant-Colonel of the General Staff, Military Attaché at the Italian Embassy at Vienna, Italy.
Stubendorff, Otto v., Colonel and Professor at the Military Academy at St. Petersburg, Russia.
Vatry, Baron de, Colonel, France.
Woods, George H., Hartford, Conn., United States of North America.

SUBSTITUTES.

Engelhardt, A., Colonel of the Imperial Russian Artillery at St. Petersburg, Russia.
Pilz, J., Dr. of the Imperial Surgical Military Inspection at St. Petersburg, Russia.
Quaratesi, Alessandro Nob., Officer in the Royal Artillery at Florence, Italy.
Wahlberg, J., Colonel of the Imperial Russian Engineer Corps, Russia.
Werchovzov, Leonidas, Secretary of the Imperial Technical Committee of the General War Intendancy at St. Petersburg, Russia.

EXPERTS.

Sect. 2. Agvist, Q., Royal Artillery Captain at Stockholm, Sweden.
Sect. 3. Billroth, Th., Dr., Counselor of the Imperial and Royal Court and Professor in the University at Vienna, Austria.
Sect. 3. Davila, Dr., General Inspector of the Sanitary Service of the Roumanian Army, Bucharest, Roumania.
Sect. 2. Gablenz, Freiherr v., Lieutenant at Berlin, Kingdom of Prussia, German Empire.
Sect. 3. Hassinger, Johann Edler v., Dr., Vienna, Austria.
Sect. 2. Huber, Major of the Artillery Staff, Zurich, Switzerland.
Sect. 2. Kostersitz, Joseph M., Imperial and Royal Major of the Technical Administrative Committee at Vienna, Austria.
——— Listing, J. B., Dr., (see Group XIV,) German Empire.
——— Lohner, Jacob, (see Group XIII,) Austria.
Sect. 3. Muhlvenzl, Franz, Dr., Imperial and Royal Regimental Surgeon at Vienna, Austria.

Sect. 3. Neudörfer, Ignaz, Dr., Imperial and Royal Regimental Surgeon and Docent of Surgeonry at the Poliklinik at Vienna, Austria.
Sect. 4. Nörregaard, H. J., Royal Artillery Captain at Christiania, Norway.
Sect. 2. Perez y Gonzalez Fausto, Army Inspector at Madrid, Spain.
Sect. 3. Reisenleitner, J., (see Group IV,) Austria.
Sect. 4. Roskierriecz, Johann, Imperial and Royal Lieutenant-Colonel at Vienna, Austria.
Sect. 4. Schönhaber, Ritter v. Wengerot Heinrich, Director of the Second Division of the Imperial and Royal Military-Geographical Institute at Vienna, Austria.
Sect. 3. Siegl, Johann Ritter v., Dr., Surgeon of the Imperial and Royal Court and Staff at Vienna, Austria.
——— Targioni-Tozzetti, Adolfo Cav., (see Group IV,) Italy.
Sect. 2. Uchatius, Franz Ritter v., Colonel in the Imperial and Royal Artillery at Vienna, Austria.
Sect. 3. Wittelshofer, Leopold, Dr., Editor of the Medical Weekly at Vienna, Austria.
——— Wurtz, A., (see Group III,) France.
Sect. 2. Zinner Emerich, Captain in the Imperial and Royal Regiment, Vienna, Austria.

Group XVII.—The navy.

PRESIDENT.

Was unable to appear—Great Britain.

VICE-PRESIDENTS.

Millosisch, Georg Ritter v., Imperial and Royal Rear-Admiral, Austria.
Palasca, Leonidas, Royal Frigate-Captain at Athens, Greece.

REPORTER.

Romako, Joseph Ritter v., Chief Imperial and Royal Engineer and Inspector of Ship-Construction, Vienna, Austria.

JURORS.

Beurmann, Hermann, Bremen Harbor, German Empire.
Devot, Naval Lieutenant at Paris, France.
Fasella Felice, Cav., Professor at the Superior Nautical School at Genoa, Italy.
Lilliehöök, C. B., Marine Commander and Chief of the Piloting, Sweden.
Littrow, Heinrich Ritter v., Royal Hungarian Sea-Inspector at Fiume, Hungary.
Mangin, Amedée, Director of the Construction of Ships, Paris, France.

Nava y Caveda Hilario, His Excellency General Inspector of Marine Engineers at Madrid, Spain.
Pullino, Giacinto, Cav., Marine Engineer at Spezzia, Italy.
Sehestakoff, J. A., Rear-Admiral, St. Petersburg, Russia.
Steinhaus, C. F., Hamburg, German Empire.

GROUP XVIII.—PUBLIC WORKS, ARCHITECTURE AND CIVIL ENGINEERING.

PRESIDENT.

Kleitz, Charles, General Inspector of the First Class of Bridges and Streets, Paris, France.

VICE-PRESIDENT.

Hasenauer, Carl Freiherr v., Architect at Vienna, Austria.

REPORTER.

Tolnay, Ludwig, Director of the Hungarian State Railroad, Buda-Pesth, Hungary.

JURORS.

Betocchi, Alessandro, Inspector of Civil Engineering at Rome, Italy.
Culmann, Professor at Zurich, Switzerland.
Derby, Nelson L.,* Boston, Mass., United States of North America.
Deutsch, J., Engineer at Vienna, Austria.
Eichler, Ritter v. Eichkorn Wilhelm, Counsellor to the Imperial and Royal Court, Vienna, Austria.
Erkoff, Leo, Professor at the Institute of Street Communication, St. Petersburg, Russia.
Fynje, J. G. W., President of the Railroad Inspection Commission at Hague, Netherlands.
Krafft, Victor, Engineer of Bridges and Streets, Langres, France.
Lance, B., Architect, Member of the Committee on Historical Works in the Ministry of Fine Arts, Paris, France.
Lechner, Ludwig, General Director of the Municipal Credit and Bank at Buda-Pesth, Hungary.
Maus, Henri, General Inspector of the Administration of Bridges and Streets, Member of the Royal Belgian Academy at Brussells, Belgium.
Niernsée, John R., Civil Engineer at Baltimore, United States of North America.
Scheidtenberger, Carl, Professor at Gratz, Styria, Austria.
Schwedler, Private Member of the Board of Works at Berlin, Kingdom of Prussia, German Empire.
Sternberg, Hermann, Carlsruhe, Grand-Duchy Baden, German Empire.
Torres-Vildósola, Luis de, General Inspector of the Engineer Corps for Roads, Canals, and Harbors, Madrid, Spain.
Vignoles, Hutton, Manchester, Great Britain.

*Appointed, but resigned.

GROUP XIX.—PRIVATE DWELLING-HOUSE, ITS INNER ARRANGEMENT AND DECORATION.

PRESIDENT.

Oordt, J. W. L. van, Counsellor of State and member of the Royal Academy of Sciences at Rotterdam, Netherlands.

VICE-PRESIDENT.

Wolff, Colonel, Zurich, Switzerland.

REPORTER.

Richard, W., Member of the Board of Works at Neu Strelitz, Grand-Duchy Mecklenburg-Strelitz, German Empire.

JURORS.

Bailly, Antoine, Member of the Board of Works of the city of Paris, France.
Montaini, P. Effendi, Architect, Chief Decorator of the Palace of the Sultan, Constantinople, Turkey.
Stehlin, Sohn, Architect at Basle, Switzerland.

GROUP XX.—THE FARM-HOUSE, ITS ARRANGEMENTS, FURNITURE, AND UTENSILS.

PRESIDENT.

Orczy, Béla Freiherr v., His Excellency President of the Royal Hungarian Exhibition, Commissariate at Vienna, Austria.

VICE-PRESIDENTS.

Collier, Peter, Professor, University of Vermont, Burlington, Vermont United States of North America.
Della-Voss, Victor, Director of the Imperial Technical School at Moscow, Russia.

REPORTER.

Cantoni, Gaetano, Director of the Royal Superior School of Agriculture and Member of the Agricultural Board at Milan, Italy.

JUROR.

Harkányi, Friedrich v., Buda-Pesth, Hungary.

SUBSTITUTE.

Aldrophe, Member of the International Juries of 1862 and 1867, France.

Group XXI.—National domestic industry.

PRESIDENT.

Launay, Maria de, Dr., General Secretary of the Superior Council in the Ministry of Public Works, Constantinople, Turkey.

VICE-PRESIDENTS.

Petros, Mirza Chan, Chief Interpreter in the Persian Ministry of the Exterior, Persia.
Vidal, Camille, Rentier, China.

REPORTER.

Römer, Florian, Dr., National Museum at Buda-Pesth, Hungary.

JURORS.

Clausson-Kaas, A., Chamber-Attendant and Captain of Horse at Copenhagen, Denmark.
Farkás-Vukotinovics, Ludwig v., Agram, Croatia, Hungary.
Hardy, McL. Mc., in the Admiralty, London, Great Britain.
Nyrop, C., Copenhagen, Denmark.
Posner, Joseph, Secretary of the Chamber of Commerce and Trade at Essegg, Croato-Slavonia, Hungary.
Rondelet, Member of the Commission for International Exhibitions and of the Municipal Council at Paris, Member of the International Jury in 1870, France.
Schnabel, Julius, Ovavicza, Hungary.
Strasser, Albert, Editor, Temesvár, Hungary.
Szaboky, Adolph, Dr., Professor of the Polytechnic School at Buda-Pesth, Hungary.

Group XXII.—Exhibition showing the organization and influence of museums of fine art as applied to industry.

PRESIDENT.

Hauslab, Franz Ritter v., His Excellency, Imperial and Royal Master of the Ordnance at Vienna, Austria.

VICE-PRESIDENTS.

Codazza, Giovanni, Director of the Royal Museum of Trades at Turin, Italy.
Baumhauer, E. H. v., Dr., Professor, Member of the Royal Academy of Sciences at Haarlem, Secretary of the Dutch Society of Sciences, Netherlands.

JURORS.

Ford, Francis Clare, of the British Embassy at Vienna, Austria.
Hefner-Alteneck, J. H. v., Dr., Director of the National Museum and General Conservator at Münich, Kingdom of Bavaria, German Empire.

GROUP XXIII.—ART APPLIED TO RELIGION.

PRESIDENT.

Gori-Pannilini, Augusto Conte de, Florence, Italy.

VICE-PRESIDENT.

Schmidt, Friedrich, Imperial and Royal Counsellor of Buildings, and Builder of the Cupola at Vienna, Austria.

JURORS.

Berger, Spence J., Manchester, Great Britain.
Boesmilwald, E., General Inspector of Historical Monuments of France, Member of the International Jury of 1867, Paris, France.
Knabl, Joseph, Professor of Ecclesiastical Sculpture at the Royal Academy at Münich, Kingdom of Bavaria, German Empire.

SUBSTITUTE.

Pollak, J. E., Dr., resident at Vienna, Austria.

GROUP XXIV.—FINE ARTS OF THE PAST. ("*Exposition des Amateurs.*")
(No jury appointed.)

GROUP XXV.—FINE ARTS OF THE PRESENT TIME.

PRESIDENT.

Crenneville, Franz Graf Folliot de, His Excellency, Imperial and Royal Chamberlain at Vienna, Austria.

VICE-PRESIDENTS.

Meissonier, Ernest, Member of the Institute (Academy of Fine Arts) and of the Commission for International Exhibitions; Member of the International Jury of 1867, Poissy, France.
Ratibor, Herzog v., Castle Randen, in Silesia, Kingdom of Prussia, German Empire.

REPORTERS.

Bruloff, Paul, Academical Artist at St. Petersburg, Russia.
Engerth, Edward Ritter v., Imperial and Royal Counsellor of the Government, Director of the Imperial and Royal Art Gallery in the Belvedere at Vienna, Austria.

JURORS.

Afinger, B., Sculptor at Berlin, Kingdom of Prussia, German Empire.
Bellefroid, General Director of the Royal Belgian Ministry of the Interior, Brussels, Belgium.
Bogolonboff, Alexis, Professor at the Academy of Fine Arts at St. Petersburg, Russia.
Boito, Camillo, Professor of the Higher Architectnre at the Royal Academy of Fine Arts at Milan, Italy.
Bounat, Léon, Historical Painter, Member of the Committee of Fine Arts for International Exhibitions, Paris, France.
Costenoble, Carl, Academical Sculpor at Vienna, Austria.
Cottier, Maurice, Member of the Committee of Fine Arts for International Exhibitions, Paris, France.
Dardel, F. v., Royal High Intendant and Chamberlain of the Cabinet at Stockholm, Sweden.
Dubois, Paul, Member of the Committee of Fine Arts for International Exhibitions, Paris, France.
Dumba, Michael, Vienna, Austria.
Dupré, Giovanna, Professor and Sculptor at Florence, Italy.
Ferstel, Heinrich Ritter v., Imperial and Royal High Counselor of Buildings, and Professor at the Technical High School at Vienna, Austria.
Friedländer, Friedrich, Imperial and Royal Academical Counselor and Artist at Vienna, Austria.
Hausen, Theophil Ritter v., Imperial and Royal High Counselor of Buildings and Professor at Vienna, Austria.
Jacoby, Louis, Imperial and Royal Academical Professor at Vienna, Austria.
Jaquemart, Jules, Engraver, Member of the Committee of Fine Arts for International Exhibitions, Paris, France.
Ibsen, H. Dr., Christiania, Norway.
Jonghe, d'Ardoye Vicomte de, His Excellency, Ambassador Extraordinary and Plenipotentiary at Vienna, Belgium.
Kate, H. ten, Artist at the Hague, Netherlands.
Knaus, Ludwig, Professor at Düsseldorf, Kingdom of Prussia, German Empire.
Knndmann, Carl, Imperial and Royal Academical Professor at Vienna, Austria.
Mariani, Cesare, Cav., Professor at the Academy of St. Lucca at Rome, Italy.
Michanx, Mon., Member of the Committee of Fine Arts for International Exhibitions, France.
Obermüller, Adolph, Substitute of the Director of the Vienna Artists' Society, Austria.
Palizzi, Filippo. Cav., Naples, Italy.

Piloty, Carl v., Professor at Munich, Kingdom of Bavaria, German Empire.
Puebla Dióscoro, Artist at Madrid, Spain.
Ráth, Georg, Judge at the Court of Cassation at Buda-Pesth, Hungary.
Rodakowski, Heinrich, Artist at Lemberg, Galizien, Austria.
Saussure, Theodor de, Geneva, Switzerland.
Schleich, Ed., Professor at Munich, Kingdom of Bavaria, German Empire.
Steffek, C., Professor at Berlin, Kingdom of Prussia, German Empire.
Strazza, Giovanni, Cav., Professor of Sculpture at the Royal Academy of Fine Arts at Milan, Italy.
Viollet, Leduc Adolphe, Artist and Member of the Committee of Fine Arts for International Exhibitions, Paris, France.
Weiss, H. G. F., Professor at Berlin, Kingdom of Prussia, German Empire.

SUBSTITUTE.

Posonzi Alexander, resident at Vienna, Hungary.

GROUP XXVI.—EDUCATION, TEACHING, AND INSTRUCTION.

PRESIDENT.

Hoyt, J. W., Dr., Member of the American Commissions of 1867 and 1873, Madison, Wisconsin, United States of North America.

VICE-PRESIDENTS.

Tschudi, F. V., Dr., Landamman, St. Gall, Switzerland. Rokitausky Carl, Dr., Counsellor of the Imperial and Royal Court, President of the Imperial Academy of Sciences at Vienna, Austria.

REPORTER.

Czedik v. Brundelsberg Alois, Curator of the Vienna Commercial Academy, Austria.

JURORS.

Achtner, M., Imperial and Royal School Inspector at Prague, Bohemia Austria.
Aguilar y Vela Antonio, (see Group XIV,) Spain.
Alvin, L., member of the Royal Academy of Belgium, Brussels, Belgium.
Arrieta, Emilio, His Excellency, Director of the National Musical School at Madrid, Spain.
Bellairminoff, J. V., member of the Scientific Committee of the Imperial Russian Ministry of Instruction, St. Petersburg, Russia.
Boughi, Ruggero, Professor at the University, and member of the High Council of Instruction at Rome, Italy.

Borneman, Egon, Dr., School Commissioner of the Royal Saxonian Ministry of Instruction, Dresden, German Empire.

Carderera, Mariano, formerly General Inspector of Elementary Education at Madrid, Spain.

Dethomas, Albert, Paris, France.

Dittes, Friedrich, Dr., Director of the Pedagogue at Vienna, Austria.

França, J. J. da. jan., Dr., Rio de Janeiro, Brazil.

Fussell, J. G. C., School Inspector at London, Great Britain.

Garcia, Blanco Antonio Maria, His Excellency, Professor at the Central University at Madrid, Spain.

Grönczy, Paul V., Buda-Pesth, Hungary.

Gréard, General Inspector of Public Instruction, and Director of the Elementary Instruction of the Seine Department, Paris, France.

Höfler, Constantin Ritter v., Imperial and Royal Counselor of the Government, Professor in the University at Prague, Austria.

Hyrtl, Joseph Dr., Counsellor to the Imperial and Royal Court at Vienna, Austria.

Königswarter, Baron de, Paris, France.

Lefébure, J., Paris, France.

Liens, C. v., High Counsellor of Buildings, Professor at the Royal Polytechnic School at Stuttgart, Kingdom of Würtemberg, German Empire.

Levasseur, E., Member of the Institute and of the Central Commission for International Exhibitions, Paris, France.

Lindner, G. A., Dr., Director of the Teachers' Institute at Kuttenberg, Bohemia, Austria.

Lützow, Carl V., Dr., Vienna, Austria.

Molnár, Aladar, Buda-Pesth, Hungary.

Moscnthal, Salomon Herman Ritter v., Dr., Imperial and Royal Counselor of the Government, and Librarian at Vienna, Austria.

Philbrick, J. D., Boston, Mass., United States of North America.

Pisko, Franz Joseph, Dr., Director of the Imperial and Royal Polytechnic School at Sechshaus, near Vienna, Austria.

Rambert, Eugen, Professor at the Confederate Polytechnic at Zurich, Switzerland.

Rogers, William, Prebendary, London, Great Britain.

Sandberg, Fr., Rector of the Seminary for Female School Teachers at Stockholm, Sweden.

Schmidt, Waldemar, Professor, Copenhagen, Denmark.

Schwammel, Edward Joseph, Imperial and Royal School Inspector at Linz, Austria.

Seelheim, F., Dr., Middelburg, Netherlands.

Tubino, Francisco Maria, (see Group XII,) Spain.

Urlichs, Dr., Counselor of the Court, Professor in the University at Würzburg, Kingdom of Bavaria, German Empire.

Weber, Joseph, Imperial and Royal School Commissioner at Prague Bohemia, Austria.
Weninger, Vincenz, General Director of the General Credit Bank at Buda Pesth, Hungary.

SUBSTITUTES.

Audrimont, Léon de, Mining Engineer and President of the National Bank at Lüttich, Belgium.
Hasselt, A. van, Brussels, Belgium.

EXPERTS.

——— Boito Camillo, (see Group XXV,) Italy.
Sect. 3. Chandelon, J., (see Group III,) Belgium.
Pav. d'K. Czartoryska, Fürstin v., His Serene Highness, Vienna, Austria.
——— Deutsch, Joël, Director of the General Austrian Jewish Institute for the Deaf and Dumb at Vienna, Austria.
Sect. 2. Dubois, Paul, (see Group XXV,) France.
——— Fenzl, Eduard, Imperial and Royal Counsellor of the Court and Director of the Botanical Garden at Vienna, Austria.
——— Frolich, Ritter v. Frölichsthal Eugen, Counsellor to the Imperial and Royal Court, Director of the Institution of Employment for Adult Blind at Vienna, Austria.
Sect. 2. Girard, Aimé, (see Group IX,) France.
——— Govi, Gilberto Cav., (see Group XIV,) Italy.
Sect. 3. Graudauer, Joseph, Imperial and Royal Professor at Vienna, Austria.
——— Hauer, Franz Ritter v., (see Group I,) Austria.
——— Hlasiwetz, Heinrich, Dr., (see Group III,) Austria.
——— Hoffer, Johann, Gymnastic Teacher at the Imperial and Royal Theresian Academy at Vienna, Austria.
Sect. 3. Kindt, J., (see Group V,) Belgium.
——— Kornhuber, Andreas, Dr., Professor at the Imperial and Royal High School of Agriculture at Vienna, Austria.
——— Leidesdorf, Max, Medical Doctor, Professor at the Imperial and Royal University Upper Döbling near Vienna, Austria.
——— Lissejous, J., (see Group XV,) France.
——— Pablasek, Mathias, Director of the Imperial and Royal Blind Institute at Vienna, Austria.
Sect. 3. Pierre, Victor, Dr., Professor at the Imperial and Royal Technical High School at Vienna, Austria.
Pav. d'K. Roditzky, Helene Baronin, Chief Directrix of the Imperial and Royal Young Ladies' Boarding School at Vienna, Austria.
——— Rossander, Jenny, (Miss,) Directrix of the Swedish Division for Women's Works, Sweden.
——— Schlager, Ludwig, Dr., Director of the Lower Austrian Government Insane Asylum at Vienna, Austria.

Sect. 3. Schneider, Franz, Dr. Professor at the Imperial and Royal University at Vienna, Austria.
——— Schrotter, Ritter v. Kristelli Anton, Dr., (see Group III,) Austria.
Pav. d'K. Stamm, Ferdinand, Dr., Vienna, Austria.
——— Storck, Joseph, Architect and Professor at the Imperial and Royal School of Art at Vienna, Austria.
——— Venus, Alexander, Director of the Imperial and Royal Institute for the Deaf and Dumb at Vienna, Austria.
——— Wagner, Rudolph, Dr., (see Group III,) German Empire.
Sect. 2. Walser, Eduard, Imperial and Royal Counselor of the Government and Director of the Communal Polytechnic School in Rossau, Vienna, Austria.
Sect. 3. Woldrich, Johann Nep., Dr., Imperial and Royal Professor at Vienna, Austria.

Special Jury.

PRESIDENT.

Jägermayer, Samuel, (see Group V,) Austria.

REPORTER.

Damböck, Ludwig, (see Group V,) Austria.

JURORS.

Aubry, Felix, (see Group V,) France.
Drächsler, Carl, (see Group V,) Austria.
Duhayon, Felix, Brussels, Belgium.
Giani, Carl, (see Group V,) Austria.

Additional Exhibitions of the Commerce and Trade of the World and of the History of Prices.

PRESIDENT.

Joy, Charles A., Professor of Chemistry at Columbia College, New York, United States of North America.

VICE-PRESIDENTS.

Goldney, G., London, Great Britain.
Gutmannsthal, Benvenuti Ludwig Ritter v., Dr., Ex-President of the Imperial and Royal Central-Marine Authorities at Trieste, Austria.

REPORTER.

Littrow, Heinrich Ritter v., (see Group XVII,) Hungary.

JURORS.

Hauslab, Franz Ritter v., His Excellency, (see Group XXII,) Austria.
Moschnin, W., (see Group VI,) Russia.

Müller, T., (see Groups II and XVII,) Norway.
Petrokokino, A., (see Group IV,) Russia.
Steinbeis, v., His Excellency, Dr., (see Group X,) German Empire.
Wiener, Ritter v. Welten Eduard, (see Group IV,) Portugal.

EXPERTS.

Kalchberg, Victor Freiherr v., Ministerial Secretary in the Imperial and Royal Ministry of Commerce, Austria.
Konek, Alexander, Dr., Buda-Pesth, Hungary.
Lindheim, Wilhelm v., Vienna, Austria.
Overbeck, Gustav Freiherr v., Imperial and Royal General Consul at Hong-Kong, Austria.

ADDITIONAL EXHIBITION OF THE HISTORY OF INVENTIONS AND INDUSTRY.

PRESIDENT.

Steinbeis, v., His Excellency, Dr., (see Group X,) German Empire.

JURORS.

Exner, Wilhelm, Dr., (see Group VIII,) Austria.
Foltz, Carl, (see Group II,) Austria.
Hornbostel, Otto, (see Group V,) Austria.
Paul, Oskar, Dr., (see Group XV,) German Empire.
Seufft, (see Group X,) German Empire.

EXHIBITION OF THE USE OF WASTE MATERIALS AND THEIR PRODUCTS.

PRESIDENT.

Hoffman, A. W., Dr., (see Group III,) German Empire.

JURORS.

Archer, (see Group IX,) Great Britain.
Chandelon, J., (see Group III,) Belgium.
Horsford, E. N., (see Group IV,) United States of North America.
Kopp, Emil, (see Group III,) Switzerland.
Matscheko, Michael, (see Group III,) Austria.
Schrötter, Ritter v., Kristelli Anton, Dr., (see Group III,) Austria.
Wagner, Rudolph, Dr., (see Group III,) German Empire.

DELEGATES FROM FOREIGN EXHIBITION COMMISSIONS.

Austey, T. H., Aldershot, Great Britain.
Bacicchi, Vincenzo A., Portugal.
Baumhauer, E. H. v., Dr., (see Group XXII,) Netherlands.
Bertone di Sambuy, Ernesto Conte, (see Group IV,) Italy.

Bertone di Sambuy, Manfredo, Cav., (see Group X,) Italy.
Blake, Wm. P., New Haven, Conn., United States of North America.
Cantoni, Gaetano, (see Group XX,) Italy.
Clerfeyt, Brussels, Belgium.
Dognée Engène, Lüttich, Belgium.
Fink, Franz, Grand Ducal Private Counselor of the Government at Darmstadt, Grand-Duchy, Hessen, German Empire.
Fontenay, France.
Grothe, Dr., (see Group VII,) Netherlands.
Herzfeld, Joseph, (see Group XV,) Hungary.
Kindt, J., (see Group V,) Belgium.
Muysken, C., (see Group IX,) Netherlands.
Nessi Luigi, (see Group V,) Italy.
Oordt, J. W. L. van, (see Group XIX,) Netherlands.
Palizzi Filippo, Cav., (see Groups IV and XXV,) Italy.
Reuleaux, Franz, (see Group XIII,) German Empire.
Rondot, Natalis, (see Group V,) France.
Scaramanga, P. A., (see Group IV,) Russia.
Schiefner-Bartha, Julius, (see Group IV,) Hungary.
Stegmann, Dr., Director of the Technical Museum at Nuremberg, Kingdom of Bavaria, German Empire.
Stösser, v., Grand Ducal Counselor of the Ministry of Baden, German Empire.
Thiel, H., (see Group II,) German Empire.
Verson Evrico, Cav., (see Group III,) Italy.
Wagner, Rudolph, Dr., (see Group III,) German Empire.
Wessely, Joseph, (see Group II,) Hungary.
Wiesner, M., Dr., German Empire.
Zamboni Giovanni, Cav., (see Group X,) Italy.

DELEGATES FROM THE GENERAL DIRECTION.

Arenstein, Joseph, Dr., Chief of the Agricultural Section of the Vienna International Exhibition.
Baner, Alexander, Dr., Professor at the Imperial and Royal High School at Vienna.
Caliee, Heinrich Freiherr, v., Imperial and Royal Resident Minister of Eastern Asiatic Courts.
Ditmar, Rudolph, Imperial Counsellor at Vienna.
Gagern, Max Freiherr v., His Excellency, Imperial and Royal Actual Private Counsellor at Vienna.
Hornig, Emil, Dr., Imperial and Royal Counsellor of the Government, and Professor at Vienna.
Isbary, Rudolph, Imperial Counsellor, and Vice-President of the Chamber of Commerce at Vienna.
Kübeck, Max Freiherr v., Imperial and Royal Counsellor of the Legation at Vienna.

Pollak, Moritz, Vienna.
Suess, Freidrich, Imperial Counsellor at Vienna.
Vesque, v., Püttlingen Johann Freiherr v., Dr., Imperial and Royal Chief of the Section at Vienna.
Zimmermann, Göllheim Carl Ritter v., Imperial Counsellor and Director of the Private Austrian National Bank at Vienna.

SECRETARY OF THE JURY.

Holdhaus, Carl, Dr., Imperial Counsellor and Secretary of the Chamber of Commerce at Vienna.

CHIEF OF THE CHANCERY.

Stpěanek, Adolph, Secretary of the Chamber of Commerce at Pilsen.

60. *The United States Commissions to the International Exposition at Vienna*, 1873.—The United States commissions were formed under the direction of the President of the United States by the Secretary of State. They were constituted as follows

EXECUTIVE COMMISSION.

H. Garretson,* Chief Commissioner.

Thomas McElrath	New York.
Lewis Seasongood	Ohio.

SCIENTIFIC COMMISSION.

Eben N. Horsford	Massachusetts.
J. Lawrence Smith	Kentucky.
Robert H. Thurston	New Jersey.
L. J. Boeck	Virginia.
John A. Warder	Ohio.
Peter Collier	Vermont.
Wolcott Gibbs	Massachusetts.

PRACTICAL ARTISANS.

N. M. Lowe	Massachusetts.
Charles Davis	Pennsylvania.
Joseph V. Meigs	Massachusetts.
Robert B. Lines	District of Columbia.
J. K. Niernsee	Maryland.
L. J. Hinton	New York.
L. Bridges	Illinois.
George A. Staubery	Ohio.

HONORARY COMMISSIONERS.

G. Dawson Coleman	Pennsylvania.
J. W. Hoyt	Wisconsin.
Frank Draxler	Alabama.
A. McDonald	Arkansas.
J. K. Kilbourne	Connecticut.
Joseph Plant	Connecticut.
E. D. Newton	Georgia.
A. W. Stolp	Illinois.
J. M. Gregory	Illinois.
Jesse J. Brown	Indiana.
J. H. Vajen	Indiana.

* Thomas B. Van Buren was appointed commissioner June 10, 1872, and served as chief of the commission until May 10, 1873; he was succeeded by Jackson S. Schultz, who served until July 5, 1873.

James A. Williamson ..... Iowa.
G. T. Carpenter ..... Iowa.
S. F. Cooper ..... Iowa.
Henry Sarstedt ..... Kansas.
C. F. Carpenter ..... Kentucky.
Frank Morey ..... Louisiana.
Henry Vignaud ..... Louisiana.
J. Edwin Sherman ..... Maine.
W. T. Walters ..... Maryland.
J. D. Philbrick ..... Massachusetts.
N. L. Derby ..... Massachusetts.
Lewis Weisbein ..... Massachusetts.
James Birney ..... Michigan.
H. C. Lewis ..... Michigan.
E. P. Jones ..... Mississippi.
Augustus Seniago ..... Mississippi.
H. C. Creveling ..... Missouri.
G. H. Koch ..... Missouri.
John C. Vogel ..... Missouri.
H. J. Winser ..... New Jersey.
J. E. Van Winkle ..... New Jersey.
John Duncan ..... New Jersey.
G. De Witt ..... New Jersey.
George Sauer ..... New York.
L. W. Rogers ..... New York.
W. C. Gunnell ..... New York.
J. H. Sherwood ..... New York.
Francis A. Stout ..... New York.
George W. Silcox ..... New York.
R. W. Raymond ..... New York.
Douglas Taylor ..... New York.
George Thurber ..... New York.
Washington C. Kerr ..... North Carolina.
O. G. Leopold ..... Ohio.
G. Mendenhall ..... Ohio.
Howard Painter ..... Pennsylvania.
Isaac Eckert ..... Pennsylvania.
H. D. Moore ..... Pennsylvania.
David Brooks ..... Pennsylvania.
J. Milliken ..... Pennsylvania.
Charles M. Nes ..... Pennsylvania.
Elisha Dyer ..... Rhode Island.
S. Tate ..... Tennessee.
L. J. Du Pré ..... Tennessee.
C. S. Morrill ..... Vermont.
Moses P. Handy ..... Virginia.

J. H. Diss De Bar	West Virginia.
E. M. Hamilton	Colorado.
R. D. Cutts	District of Columbia
David Edes	District of Columbia.
A. H. Brown	District of Columbia.
J. R. Dodge	District of Columbia.
J. M. Cavanaugh	Montana.
Adolph Guttman	New Mexico.
G. W. Smalley	
J. Russell Young	
B. R. Winthrop	
C. K. Tuckerman	
Dr. Thomas Buekler	
Edward M. Gallaudet	
Charles Francis Adams, jr	Massachusetts.
George L. Allen	Missouri.
Albert Havemeyer	New York.
Edward Seguin	New York.
Charles H. Adams	New York.
Clarence G. Dinsmore	New York.
Andrew E. Rankin	Vermont.
Lewis H. Frazer	Virginia.
George H. Stuart	Pennsylvania.
William P. Brock	New Jersey.
T. B. Peddie	New Jersey.
Charles Turner	Alabama.
John S. Sammis	Florida.
John H. Yager	Illinois.
L. D. M. Sweat	Maine.
De Courcy May	Maryland.
William A. McKellip	Maryland.

MACHINERY HALL.

Mr. T. F. Pickering, superintendent and engineer.

INDUSTRIAL PALACE.

Mr. Henry Reek, superintendent and architect.

61. *Advisory committee of citizens.*—A committee of citizens was organized at New York, in the year 1872, which assisted the Executive Commission by urging upon the people of the United States the importance of securing a creditable representation at Vienna, revising the applications for space, and assisting the Chief Executive Commissioner in the selection of exhibits and apportionment of space. It had the following organization:

ADVISORY COMMITTEE.

CHAIRMAN.—Hon. Samuel B. Ruggles.
Secretary.—Prof. Charles A. Joy, Columbia College.

Group.

1. Mining—Prof. William P. Blake.
2. Agriculture—Mr. H. W. Sargent.
3. Chemistry—Prof. Charles F. Chandler.
4. Food—Prof. Eben N. Horsford.
5. Textile fabrics—Dr. Isador Walz.
6. Leather—Mr. Jackson S. Schultz.
7. Iron and steel—Mr. Abram S. Hewitt.
8. Wood industry—Mr. George E. Harney.
9. Glass and pottery—Prof. T. Sterry Hunt.
10. Jewelry—Mr. Charles L. Tiffany.
11. Paper—Mr. Alexander H. Rice.
12. Engraving—Mr. John E. Gavit.
13. Machinery—Prof. Robert H. Thurston.
14. Philosophical instruments—Dr. F. A. P. Barnard.
15. Musical instruments—Mr. Theodore Thomas.
16. War materials—Gen. Q. A. Gillmore.
17. Naval materials—Mr. Isaac Newton.
18. Engineering—Mr. William E. Worthen.
19. Model dwellings—Mr. Calvert Vaux.
20. Farm buildings—Mr. Orestes Cleveland.
21. Domestic industry—Mr. Salem H. Wales.
22. Museums for the people—Mr. Howard Potter.
23. Religious art—Dr. Henry C. Potter.
24. Loan collections—Mr. John Taylor Johnston.
25. Fine arts—The President of the Academy of Design.
26. Education—Mr. Hooper C. Van Vorst.

Additional groups.

1 and 2. The history of inventions—Prof. Samuel D. Tillman.
3 and 4. Charitable institutions—Mr. Charles L. Brace.
5. Commerce—Mr. Samuel B. Ruggles.
6. Geographical and trade statistics—Mr. Francis A. Stout.

62. *Regulations for the guidance of officers of the United States connected with the Vienna International Exhibition of* 1873, were issued from the Department of State, as follows:

DEPARTMENT OF STATE,
Washington, March 1, 1873.

I.

The commissioners appointed as practical artisans and as scientific men will make reports presenting a brief general survey of the Exhibition, and a similar report upon the character and condition of the American Exhibition, and of their doings and observations.

They will make special reports upon inventions, and upon the various products displayed, which are most advanced in the sciences, in the arts, and in industry, giving a practical description of the methods and processes connected with such products.

Similar reports will be made upon mineral and agricultural products of importance, and upon raw materials, and manufactures of great general use, or displaying remarkable skill and merit; upon implements, machines, tools; on metallurgy, and the extractive arts in general; on the products of chemistry, and the preparations of food and clothing; and on any other subject connected with the Exhibition, and relating to the material, moral, and intellectual well-being of the nation.

To accomplish this work the commissioners above mentioned will proceed as follows:

First. On or before the opening of the Exhibition, 1st May, 1873, they will assemble in Vienna, and meet for the purpose of organization, at which meeting the Commissioner, if present, will preside. As many as shall then be present will constitute a quorum.

Second. They will then, together with the Commissioner, constitute themselves a committee, and proceed to elect a presiding officer and secretary for committee meetings, which will be held as often as in their opinion the work may require.

Third. At these meetings the committee will decide, from time to time, on the subjects for special reports, and designate the persons who will undertake the investigation and studies each report will require. They may designate persons from among the honorary commissioners to undertake investigations and studies and to make special reports.

Fourth. Each report will be made on the responsibility of the person charged with it, and he will sign his name to it. The reports will be transmitted to the Department of State, with as little delay as may be practicable, after the close of the Exhibition.

Fifth. The Commission is understood to consist of the Commissioner and his thirteen assistants; practical artisans, eight in number; scientific men, seven in number; honorary commissioners, not exceeding one hundred in number.

Any member of the Commission who may be nominated on international juries will perform that service.

Nominations to serve on international juries will be made by the committee named in the second article, unless some other mode of nomination be prescribed by the regulation of the Imperial Commission.

Sixth. The commissioners, whether practical artisans, scientific men, or honorary commissioners, may be nominated on international juries, and those who may be nominated will perform that service.

Seventh. There will be regular meetings of the whole Commission as often as once a month, at which meetings the commissioner, when present, will preside. If he be unable to be present, he may in writing designate some commissioner to preside.

The American minister in Vienna may designate some commissioner to preside at all meetings of the Commission in the event of the absence of the Commissioner, and of no person being present designated in writing by him to preside at such meeting.

A majority of all the members constituting the Commission shall not be required for the transaction of business at those meetings.

Eighth. The committee named in the second article will report at these meetings the progress made, and the reports which have been completed will be read to the meeting by their authors, and then delivered to the Commissioner for transmission to the Department of State, for presentation to the President.

Ninth. The meeting shall not be competent to reject any report. But observations may be made on each report by any Commissioner, and he may reduce his remarks to writing and send them with the report, if he so desire.

It will be in order to decide upon subjects for special reports at the general meetings, as well as in meetings in committee.

Tenth. The Commissioner may call meetings of the whole Commission for consultation as often as deemed necessary. Commissioners of all classes are expected to attend the monthly and also the special meetings which may be called by the Commissioner.

Eleventh. The Commissioner is entitled to call upon the members of the Commission, of whichever class, for their advice and assistance in his department. Their assistance so given will be voluntary, and their counsel advisory.

Twelfth. A brief record of the proceedings of the general meetings will be kept for transmission to this Department.

II.

The Commissioner is charged with the supervision and management of the American department of the Exhibition.

He will receive the products on their arrival in Austria and place them for exhibition, and he will conduct the exhibition in conformity with the regulations of the Imperial Commission.

The employés, whether paid by him or by exhibitors, and all persons engaged in explaining or exhibiting products, or occupied on the premises, will be under his direction; also the application of motive force to machinery.

First. The "over-head gear" straps, pulleys, &c., for machinery in action, together with the materials and laborers for working the machinery and keeping it in order, will be at the expense of the owners of the machines.

Second. The Commissioner will provide laborers for keeping the apartments in order, linguists for explanations, and subsidiary police or guards for the protection of property and preservation of order; the

number of persons to be so employed is left to his judgment, he having regard to the necessities, and to the funds for this purpose placed at his disposal.

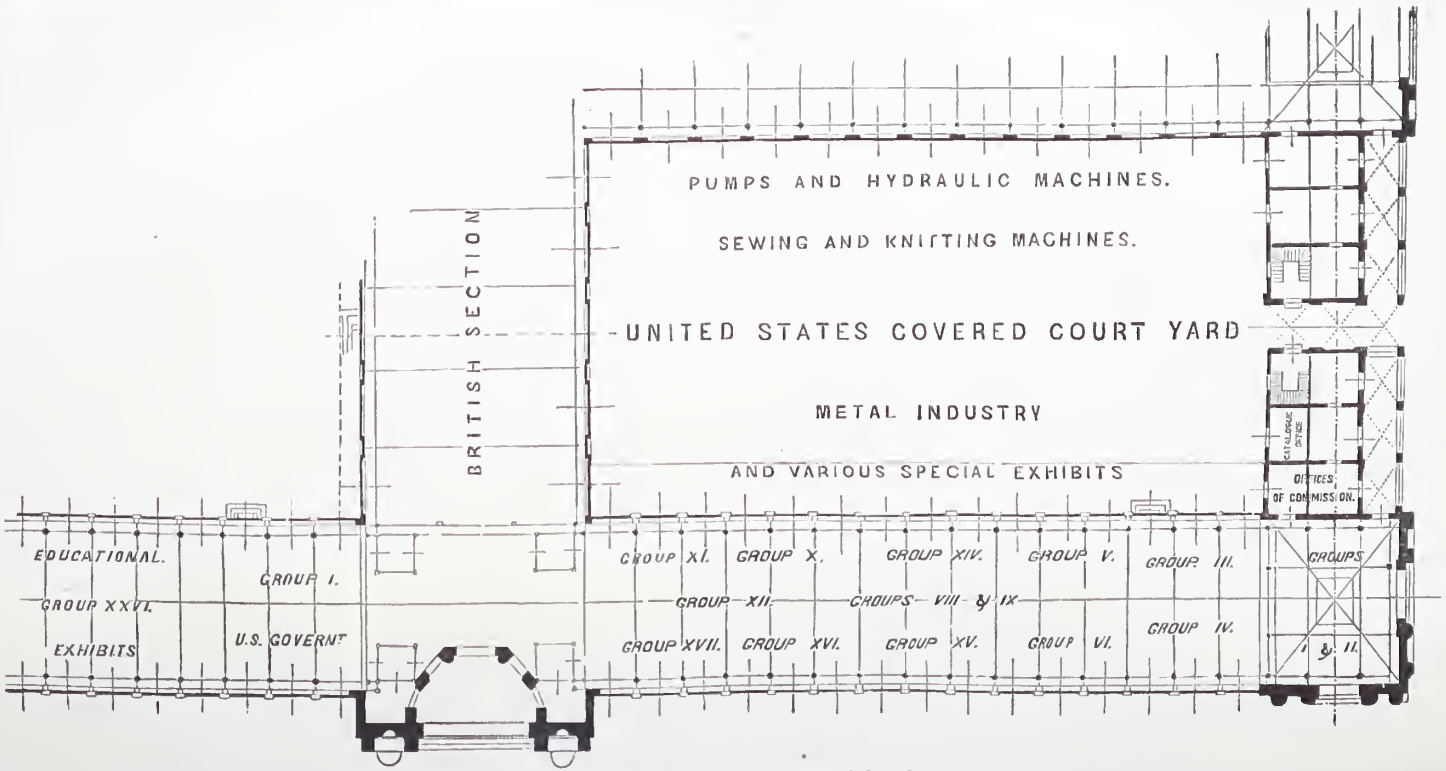
Exhibitors may introduce employés in connection with their products, at their own expense, but they shall not so introduce them without the consent of the Commissioner, and such employés will be under his direction.

Third. The Government will not be responsible for damages, thefts, or destruction of property; and insurance against all contingent risks to property, either in the Exhibition or in transitu, is left to the care and cost of the owners, respectively.

Fourth. With the closing of the Exhibition in conformity with the regulations of the Imperial Commission, the Government control and charge of the property will cease, and the Commissioner will deliver the products to the order of the respective owners, who will receipt for it, which delivery will be made at the place of exhibition. Property not applied for and removed by the owners within the period fixed by the regulations of the Imperial Commission for that purpose will be at the risk of the owners, and subject to the charges which may accrue upon it.

Fifth. The Commissioner will be responsible for the public money placed at his disposal, and will render the accounts of his expenditures to this Department.

HAMILTON FISH.



United States section—Industrial Palace.

PLATE V.

63. OFFICIAL CATALOGUE OF THE UNITED STATES SECTION OF THE EXHIBITION.

The following catalogue of the exhibits entered in the United States section of the Exhibition was published at Vienna for the use of the International Jury, the several commissions, and of the exhibitors, in polyglott form. The English, French, and German languages were officially announced as allowable in official documents and in debates of the International Jury:

CATALOGUE.

GROUP I.—MINING, QUARRYING, AND METALLURGY.

Mineral Fuels, (Coals, Shales, and Mineral Oils.) Mineral Ores and Metals. Other Minerals, (as Salt, Sulphur, Graphite, &c.;) not including Building Materials; *vide* Group 18. Natural Alloys. Drawings and Models of Objects Relating to Mining, Metallurgy, and Mineral Industry, Mining Engineering, Surveying and Map Making. Geological Works, and Geological Maps, &c. Tools and Inventions for Mining and Metallurgy—for Underground and Surface Work. Statistics of Production.

(1.) THE NEW ORLEANS ACADEMY OF SCIENCES, New Orleans, La.—Specimens of the natural history of the State of Louisiana.

(2.) CINCINNATI, ROCKPORT & SOUTHWESTERN RAILWAY, Cincinnati, Ohio.—Block coal, bituminous coal, whetstone grit, grindstone grit.

(3.) JOSEPH WHARTON, Philadelphia, Pa.—Metallic nickel, cobalt, nickel and cobalt salts, castings of nickel and cobalt, blue vitriol, copperas; ore of Gap mine, Pennsylvania, source of the above products. Matte of Gap furnace and pure zinc.

(4.) E. B. WARD, Detroit, Mich.—Iron, copper, and silver ores.

(5.) CHARLES M. NES, York, Pa.—Silicon steel, with furnace and steam hammer used in its manufacture.

(6.) BIG MUDDY IRON COMPANY, Saint Louis, Mo.—Varieties of pig iron manufactured by the exhibitors.

(7.) HENRY T. BLOW, Saint Louis, Mo.—Zinc, (silicate,) ore from Granby; zinc, (sulphate,) ore from Minnesota; lead ore from Granby.

(8.) Prof. J. L. TRACY, Saint Louis, Mo.—Minerals from Western United States.

(9.) MINERAL CITY MINING AND SMELTING COMPANY, Mineral City, Ill.—Pig-lead, lead ores, and fluor spar; lead ores, silver-bearing, dressed; pig-lead, silver-bearing; case of various minerals.

(10.) GEORGE R. TUTTLE, Cleveland, Ohio.—Specimens of iron ore

from each of the leading iron mines from the Lake Superior (Michigan) district; statistics of mining, &c.

(11.) AMASA MCCOY & PHILO NORTON, Philadelphia, Pa.—Samples of coals, cokes, smelting coke, limestone, fire-clay rock, iron ores, and sand for glass-making purposes.

(12.) P. P. PECK, Denver, Colo.—Minerals, fossils, and petrifactions from the leading gold-mining regions of the United States.

(13.) SANTEE & WAGNER, Rolla, Mo.—Iron, lead, and copper ores.

(14.) JOHN M. KRUM, Saint Louis, Mo.—Specimens of iron ores.

(15.) MENDENHALL & KITCHELL, Cincinnati, Ohio.—Pig and bar iron, and the coals, coke, and ores used in manufacturing the same at Shoals, Indiana.

(16.) C. S. JOHNSTON, New York.—Specimens of magnetic iron ore from the mines at Clifton, New York, with illustrations, of geological phenomena, analyses, and reports, by Professor Silliman, of New Haven, Conn.

(17.) GRAND PIER MINING AND MANUFACTURING COMPANY, Shawneetown, Ill.—Galena, fluor spar, pyrites, surface rocks, zinc-blende, &c.

(18.) HUSSEY & HOWE MINING COMPANY, Plattsburg, N. Y.—Ores.

(19.) W. B. KOONTZ, President Calcasieu Sulphur and Mining Company, New Orleans, La.—Crude and clarified sulphur.

(20.) PRICE, HINE & TUPPER, New Orleans, La.—Specimens of Louisiana rock-salt.

(21.) JACOB F. S. SCHIRMER, assayer in charge of the United States mint, at Denver, Colo.—Collection of minerals and ores from Colorado.

(22.) GEO. W. BECKWITH, Burlington, Vt.—Samples of Green Mountain soluble phosphates.

(23.) THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.—Dixon's pure American graphite for electrotyping, lubricating, polishing, &c. Specimens of crude graphite.

(24.) RICHARD P. ROTHWELL, New York.—Iron ores and coal from Alabama; topographical map, in contour of the Wyoming anthracite coal-fields, Pennsylvania; topographical map, with sections, of the coal measures of the Panther Creek Valley, Pennsylvania.

(25.) PROF. GUIDO KUSTEL, San Francisco, Cal.—Ores and minerals from Utah and California.

(26.) SAMUEL A. MILLER, Cincinnati, Ohio.—Ohio geological and paleontological reports.

(27.) THE INGERSOLL ROCK DRILL COMPANY, New York.—Ingersoll's improved steam rock-drill.

(28.) SUTRO TUNNEL COMPANY, Sutro, Nev.—Topographical model of Comstock Lode. Sutro Tunnel, and surroundings; collection of minerals, books, and maps relating thereto.

(29.) PROF. RAPHAEL PUMPELLY, Missouri.—Minerals and ores of Missouri.

(30.) MOHRHARDT & ROBISON, Bethany, Pa.—Specimens of gold quartz.

(31.) RAVOLD IRON COMPANY, Saint Louis, Mo.—Iron and iron ores; brown hematite and blue specular, containing sixty-eight per cent. of metallic iron. (From Crawford County, Missouri.)

(32.) WITHERBY, SHERMAN & Co., Port Henry, N. Y.—Iron and other ores.

(33.) J. & J. ROGERS IRON COMPANY, Ausable Forks, N. Y.—Blooms and rolled iron and iron ores.

(34.) NORTHERN PACIFIC RAILWAY, New York.—Geological specimen from the line of the Northern Pacific Railway Company.

(35.) HENRY RICHMAN, Cincinnati, Ohio.—Model of Dank's rotary puddling furnace.

(36.) STATE OF INDIANA, by E. T. Cox, State Geologist, Indianapolis. —Coals, iron, and stone.

GROUP II.—AGRICULTURE, HORTICULTURE, AND FORESTRY.

Plants for Food and Medicine (excluding Fresh Fruits and Vegetables, which are to be the subject of temporary exhibitions.) Tobacco and other Narcotic Plants. Vegetable Fiber, (as Cotton, Flax, Hemp, Jute, China Grass, &c.,) and other Plants of Commerce in their raw state. Cocoons of Silk Worms. Animal Products in a Raw State, (Skins, Hides, Feathers, Bristles, &c.) Wool. Products of Forestry, (Timber, Wood for Cabinet Work, Tanning Substances, Resin in a raw state, Dyeing Woods, Barks, Charcoal Tinder.) Peat and its Products. Manures. Drawings and Models of Objects used in Agriculture, Horticulture, and Forestry; Farm Maps. Works of the Experimental Stations, Woodland and Forest Doom Books, Statistics of Forests, &c. Processes and Inventions for Producing, Transporting, and Storing the above-mentioned Products. Plans of Gardens, Drawings and Models of Horticultural Implements, Hot-Houses, Conservatories, Irrigation, &c. New Methods of Horticultural Cultivation. Statistics of Production.—(*Vide* Temporary Exhibition, No. 4.)

(37.) ALCUS SHERK & AUTE, New Orleans, La.—Sugar-cane.

(38.) HERMAN DANZINGER, Cicinnnati, Ohio.—Agricultural products.

(39.) Prof. J. L. TRACY, Saint Louis, Mo.—Cereals and other products of the Western United States.

(40.) ANGELO SOCOLA, New Orleans, La.—Clean and rough rice.

(41.) CHARLES BOLAND, New Orleans, La.—Pecan and ground nuts.

(42.) LEWIS L. ARMISTEAD, Lynchburg, Va.—Tobacco in packages and bulk.

(43.) TOBACCO TRADE ASSOCIATION, Cincinnati, Ohio.—Leaf tobacco.

(44.) CRAIG ALEXANDER, Saint Louis, Mo.—Leaf tobacco.

(45.) LEWIS NEWBURGH & BRO., Cincinnati, Ohio.—Samples of leaf tobacco, crops of 1871–'72, grown in Montgomery County, Ohio.

(46.) NORTHERN PACIFIC RAILWAY COMPANY—Productions from the line of the Northern Pacific Railway.

(47.) STATE OF INDIANA, by E. T. Cox, State geologist, Indianapolis.—Farm products and timber.

(48.) IDMOND BOURGEOIS, Saint James Parish, La.—Perique tobacco in carottes.

(49.) MOBILE COTTON EXCHANGE, Mobile, Ala.—Cotton.

(50.) F. INGATE, Mobile, Ala.—Cotton.

(51.) WARREN TALBOTT & Co., Saint Louis, Mo.—Hemp and hempseed.

(52.) THEODORE WILKINS, New York—Moss and excelsior.

(53.) NEW ORLEANS COTTON EXCHANGE, New Orleans, La.—Nine bales of cotton, with statistics.

(54.) AMATEUR, New Orleans, La.—Ramie fiber, bleached by a new process.

(55.) WM. M. PINCKARD, New Orleans, La.—Cotton stalks from various seeds and soils, with squares and open bolls; case of bolls in all their stages; cotton-seed of all varieties of fiber.

(56.) SELL & Co., Saint Louis, Mo.—Samples of cotton.

(57.) PRESSPRICH & Co., New Orleans, La.—Cotton-plants.

(58.) JOSEPH RAYMOND, New Orleans, La.—Moss.

(59.) W. B. & W. S. MCSHAN, Lee County, Mississippi—Bale of cotton.

(60.) B. F. LYTLE, Linneus, Mo.—Vegetable fiber, raw cotton.

(61.) GEORGE HILDEBRAND, New Orleans, La.—Bale of black moss.

(62.) N. W. MCCALL, New Orleans, La.—Bale of lowland cotton.

(63.) WILLIAMS, RUPERTI & Co., New Orleans, La.—Bale of Louisiana cotton.

(64.) FRED. J. KNAPP, New Orleans, La.—Ramie plants; ramie fiber in various conditions. (Ramie fiber manufactured into dress goods, Group V.)

(65.) J. RYKOSKI, New Orleans, La.—Black Louisiana moss.

(66.) SOUTHERN RAMIE-PLANTING ASSOCIATION, New Orleans, La.—Ramie fiber; jute fiber.

(67.) ADOLPH E. BADER, Austrian Consul, New Orleans, La.—Varieties of sugar-cane.

(68.) A. D. BULLOCK & Co., Cincinnati, Ohio.—Hair and bristles.

(69.) HENRY TRENCHARD, San Antonio, Texas.—Wools of Texas and New Mexico.

(70.) S. GOTTGETREU, New York.—Largest logs of black walnut ever cut. (Park.)

(71.) ROBERT H. COLLYER, London, England.—Specimens of flax and hemp.

(72.) J. W. JEFFERSON & Co., Memphis, Tenn.—Upland cotton.

(73.) NEW ORLEANS SANITARY AND FERTILIZING COMPANY, New Orleans, La.—Pelican fertilizer, or ammonia-fixed guano. (Park.)

(74.) STERN'S FERTILIZER AND CHEMICAL MANUFACTURING COMPANY, New Orleans, La.—Fine ground bone, raw bone superphosphate, variety of bone-black. (Copperas, neat's-foot oil, Group III.)

(75.) A. J. INGERSOLL, New Orleans, La.—Bale of cotton.

(76.) STATE OF MISSOURI, by Henry Fleischman, Saint Louis, Mo.—Books and statistics on the agriculture of the State of Missouri.

GROUP III.—CHEMICAL INDUSTRY.

Chemical Products for Technical and Pharmaceutical Purposes, (Acids, Salts, Chemical Preparations of all sorts.) Raw Substances and Products of Pharmacy, (Mineral Waters, &c.) Fats and their Products, (Stearine, Oil, Acids, Glycerine, Soaps, Candles, and Tapers, &c.) Products of Dry Distillation, (as Refined Petroleum, Slate Oil, Paraffine, Phenylic Acid, Benzoine, Aniline, &c.) Ethereal Oils and Perfumeries. Matches, &c. Dye-stuffs, Mineral and Organic. Resins, (Washed, Dyed, or Bleached,) Sealing-wax, Varnish, Albumen, Isinglass, Glue, Starches, Dextrine, &c. Contrivances and Processes used in Chemical Production. Statistics of Production.

(77.) CHARLES W. ZAREMBA, Saint Louis, Mo.—Wine, sirup, and compound pills of boldo; boldo powder for cattle; compound fluid extract of boldo.

(78.) JOSEPH H. HIRSCH, Chicago, Ill.—Albumen, dextrine, pepsin, lactrine, golcorine, glycerine, grape sugar, essential oils, extract of malt, starch, ethers, carbolic acid, hydrate of chloral, printing ink, and roller compound.

(79.) WM. R. WARNER & Co., Philadelphia, Pa.—Thirty-five varieties of sugar-coated pills and granules.

(80.) EMIL SCHEFFER, Louisville, Ky.—Pepsin.

(81.) CHARLES T. WHITE & Co., New York.—Medical chemicals.

(82.) BOLEN & BYRNE, New York.—Artificial mineral waters.

(83.) W. J. M. GORDON, Cincinnati, Ohio.—Sugar-coated pills and granules, glycerine, podophyltin, hydrastin, and other proximate principles.

(84.) COLGATE & Co., New York.—Toilet-soaps.

(85.) PROCTOR & GAMBLE, Cincinnati, Ohio.—Soap and candles.

(86.) SAMUEL JEFFREY & Co., Cincinnati, Ohio.—Ointment.

(87.) THOMAS EMERY'S SONS, Cincinnati, Ohio.—Lard, tallow, and wool oils, and star candles.

(88.) GEST & ATKINSON, Cincinnati, Ohio.—Lard, signal, paraffine, mineral, and lubricating oils; vegetable oils; head-light and steamer oils; patent wax candles for railway-coaches.

(89.) BURCKHARDT & Co., Cincinnati, Ohio.—Double-refined, winter-strained lard-oil; standard white illuminating petroleum, fire-test 110° F.; lubricating petroleum, crude, gravity 28°; safety head-light oil, (petroleum,) fire-test 175° F.

(90.) CASWELL, HAZARD & Co., New York.—Cod-liver oil and elixir of calisaya bark.

(91.) ECLIPSE LUBRICATING OIL COMPANY, New York.—Lubricating oils.

(92.) Bienville Oil-Works, New Orleans, La.—Cotton-seed oil, oil cake and meal, cotton-seed oil-soap, cotton-seed, and cotton-seed hulls.

(93.) Ig. Symanski, New Orleans, La.—Crude and refined cotton-seed oil, cotton-lint, cotton-seed and its products.

(94.) F. S. Pease, Buffalo, N. Y.—Mineral, animal, and vegetable oils, compound oils, refined and improved for lubricating and illuminating purposes.

(95.) Alex. Fries Brothers, New York.—Artificial fruit and liquor essences.

(96.) Hale & Parshall, Lyons, N. Y.—American essential oils.

(97.) Paine Brothers, New York.—Peppermint, spearmint, wintergreen, sassafras, and other American essential oils.

(98.) H. G. Hotchkiss, Lyons, N. Y.—Essential oils.

(99.) L. B. Hotchkiss, Phelps, N. Y.—Peppermint, spearmint, wintergreen, sassafras, and other American essential oils.

(100.) Van Deusen Brothers, Kingston, N. Y.—Oil of wintergreen.

(101.) F. S. Pease, Buffalo, N. Y.—Pure white lead.

(102.) Weeks, Dupee & Soren, Boston, Mass.—Specimens of Aurantine, with cloth and wools dyed by the same.

(103.) J. Zuker & Co., New York.—Jewelers' rouge.

(104.) D. A. Dougherty, Kittanning, Pa.—Writing-fluid.

(105.) Andrew Erkenbrecher, Cincinnati, Ohio.—Starches.

(106.) Bridge & Son, New Orleans, La.—Resins and oils of Louisiana

(107.) Oleophene Oil Company, New York.—Samples of kerosene-oil.

(108.) James B. Horner, New York.—Variety of essential oils.

(109.) William F. Nye, New Bedford, Mass.—Sewing-machine and watch oil.

(110.) Stein, Hirsch & Co., Chicago, Ill.—Blood-albumen, corn-starch, &c.

(111.) George Fox, Cincinnati, Ohio.—"Superior," "Diamond-Gloss," and "Silken Gloss" starch, and corn-starch.

(112.) McKesson & Robbins, New York.—American oils, barks, roots, extracts, pills, and sponges.

(113.) Stevenson Brothers & Co., Philadelphia, Pa.—Twelve blocks of refined paraffine, made from Pennsylvania petroleum.

(114.) Henry Bowen, Philadelphia, Pa.—Crystals of yellow prussiate of potash; pure inodorous glycerine.

(115.) Morse Brothers, Canton, Mass.—Stove-polish.

Group IV.—Substances of food as products of industry.

Flour and other Farinaceous Products. Malt and its Products. Sugar and its Products. Spirits and Spirituous Liquors, &c. Wines. Ale, Beer, Porter, &c. Vinegars. Preserves and Extracts, (Extracts of Meat, Portable Soup, Condensed Milk, Preserved Vegetables, Preserved Meat, &c.) Tobacco and similar Manufactures. Confection-

ery, Ginger-bread, Chocolate, Coffee Substitutes, &c. Processes and Inventions for Preparing all these Articles. Statistics of Production.

(116.) G. C. THILENIUS, Cape Girardeau, Mo.—Flour.

(117.) H. HARVEY'S SONS, Cleveland, Ohio.—Ohio flour.

(118.) ALLARD & SON, Paducah, Ky.—Flour.

(119.) CHARLES HOLMES, Saint Louis, Mo.—Assortment of crackers in twenty varieties.

(120.) WOOD, MAUDE & Co., Saint Louis, Mo.—Pearl hominy, pearl grits, and fine pearl meal.

(121.) ENGS & TYRRELL, New York.—Imperial Scotch oat-meal.

(122.) S. B. RICKERSON & Co., Burlington, Vt.—Flour of white winter-wheat.

(123.) PELTON & DUNBAR, New Orleans, La.—Louisiana sirup.

(124.) WARDEN & COOPER, Valley Junction, Ohio.—Corn, flour, hominy, grits, and "maizola."

(125.) JOHN J. BARR & Co., New Orleans, La.—Sugar and sirup.

(126.) DUNCAN F. KENNER, Ascension Parish, La.—Yellow sugar.

(127.) BRADISH JOHNSON, New York.—White and yellow sugars.

(128.) THOMAS ONG, Saint Bernard Parish, La.—Specimens of sugar made by open-kettle and steam-pan processes.

(129.) ARTHUR DENIS, New Orleans, La.—Cane-sugar; open-kettle process.

(130.) PATRICK J. KENNEDY, New Orleans, La.—Sugar clarified by sulphur and lime; open-kettle process.

(131.) J. C. BEARD, West Baton Rouge, La.—Sugar; open-kettle process.

(132.) D. B. PENN, New Orleans, La.—Sugars; vacuum-pan process.

(133.) L. F. GENERES, New Orleans, La.—Sugar; open-kettle process.

(134.) ADOLPH E. BADER, Austrian Consul, New Orleans, La.—Sugars and molasses.

(135.) E. LAWRENCE, Parish of Placquemines, La.—Clarified sugars from lands cultivated wholly by steam.

(136.) CRESCENT CITY STEAM SUGAR REFINERY, A. THOMPSON & Co., New Orleans, La.—Refined sugars and sirups.

(137.) HENRIETTA DAVIDSON, New Orleans, La.—Sugar; open-kettle centrifugal, without bone-black.

(138.) FAIRBANKS & GILMAN, New Orleans, La.—Louisiana crystal sirup, made from Philadelphia blackstrap molasses.

(139.) CHARLES & A. ROMAN, Saint James Parish, La.—Yellow sugar; centrifugal process.

(140.) MADAME C. WAGGAMAN, Parish of Jefferson, La.—Brown sugar; open-kettle process.

(141.) BEHAN, THORN & Co., New Orleans, La.—One barrel alcohol.

(142.) JOHN GIBSON'S SON & Co., Philadelphia, Pa.—Samples of rye

whisky of the years 1867, 1868, 1869, and 1870; and wheat whisky of 1869 and 1870.

(143.) CHARLES LEDIARD, New York.—American cocktail bitters.

(144.) MILTON J. HARDY & Co., New York.—Samples of whiskies.

(145.) T. & J. W. GAFF & Co., Aurora, Ind.—Samples of Bourbon and rye whiskies.

(146.) H. K. THURBER, New York.—"Old Bourbon" whisky.

(147.) MADDOX, HOBART & Co., Cincinnati, Ohio.—Case of gin.

(148.) H. A. CHALVIN, New York.—Cordials.

(149.) MOREHEAD, YOUNG & Co., Saint Louis, Mo.—Samples of whiskies.

(150.) M. WERK & SONS, Cincinnati, Ohio.—Still and sparkling Catawba wines.

(151.) ISIDOR BUSH & Co., Saint Louis, Mo.—Still red wines from the Cynthiana grape.

(152.) CINCINNATI WINE COMPANY, Cincinnati, Ohio.—Sparkling and still wines.

(153.) WILLIAM HENRY MILLS, Sandusky, Ohio.—Champagne, sparkling Catawba, and Catawba of 1867. Hock and Delaware wine.

(154.) GEORGE BOGEN & Co., Cincinnati, Ohio.—Still and sparkling Catawba and red wines.

(155.) G. GROEZINGER, Ruyter & Co., agents, New York.—Wines and brandies.

(156.) CHARLES BOTTLER, Cincinnati, Ohio.—Sparkling Catawba wines.

(157.) AMERICAN WINE COMPANY, Saint Louis, Mo.—"Imperial" Champagne, Virginia seedling, and Missouri Catawba wines.

(158.) PLEASANT VALLEY WINE COMPANY, Hammondsport, N. Y.—"Great Western," "Carte Blanche," and "Paris Exposition" Champagne. Still wines and brandies.

(159.) POESCHEL & SHERER, Harreman, Mo.—Wines of the following varieties: Catawba, Gœethe, Hebemont, Delaware, Taylor, Rulander, Nortons, Virginia, Cynthiana.

(160.) URBANA WINE COMPANY, New York.—"Sparkling Gold Seal," and "Sparkling Imperial."

(161.) BUENA VISTA VINICULTURAL SOCIETY, San Francisco, Cal.—"Pearl of California," (Nonpareil.) Buena Vista, first and third quality,

(162.) EMORY CUMMINGS, New York.—100 jars preserved fruits, meats. &c.; uncooked. The invention of Miss Amanda T. Jones and Leroy C. Cooley, Ph.D.

(163.) MERREL & SOULE, Syracuse, N. Y.—Packed fruits and provisions; fresh tomatoes, sweet corn, and apples.

(164.) WILLIAM UNDERWOOD & Co., Boston, Mass.—Canned fruits, fish, vegetables, and meats.

(165.) AUGUST J. MURDOCK, New York.—American mustard.

(166.) PORTLAND PACKING COMPANY, Portland, Me.—Meats, fish, and vegetables, hermetically preserved.

(167.) JAMES MORRISON & Co., Cincinnati, Ohio.—Sugar-cured hams, lard, and bacon.

(168.) AMERICAN AND EUROPEAN CRYSTALLIZED EGG COMPANY, New York.—Crystallized egg.

(169.) B. A. ANGER, New Orleans, La.—Extract Mexican pepper, tomato catsup, raw tomato juice, Mexican pepper-sauce.

(170.) W. H. TROWBRIDGE, Danville, Va.—Tobacco.

(171.) GEORGE S. SHRYOCK, Saint Louis, Mo.—Plug, smoking, and leaf tobacco.

(172.) WILLIAM S. KIMBALL, & Co., Rochester, N. Y.—One drum and two cases "Peerless" Tobacco; one case "Vanity Fair" Tobacco.

(173.) AMERICAN BONELESS SARDINE COMPANY, New York.—Sardines.

(174.) WALTER BAKER & Co., Boston, Mass.—Chocolate and cocoa preparations.

(175.) D. LOPEZ, New Orleans, La.—Assorted chocolate.

(176.) WATERLOO YEAST COMPANY, New York.—Twin Brother's yeast.

(177.) ROYAL BAKING-POWDER COMPANY, New York.—Royal baking-powder, English baking-powder, and English (dry) fruit flavors.

(178.) J. H. CHRISTMAN, Syracuse, N. Y.—Cigar-trimmer.

(179.) CINCINNATI SHEET-METAL CIGAR-MOLD COMPANY, Cincinnati, Ohio.—Cigar molds and shape or trimmer.

(180.) PORK-PACKERS' ASSOCIATION, Cincinnati, Ohio.—Three cartoons, illustrating the pork slaughtering and packing industry, as conducted at Cincinnati, Ohio.

(181.) FAIRBANKS, PECK, & Co., Chicago, Ill.—Refined lard.

GROUP V.—TEXTILE INDUSTRY AND CLOTHING.

Washed Wool and Hair used for Textile Fabrics, Carded Wool and Worsted, Combed Wool and Woolen Fabrics, Felt Carpets, Blankets, Hair Tissues, Mixed Fabrics, including Shawls. Cotton, Cotton Substitutes, Cotton Thread, Cotton Fabrics, and Cords. Flax, Hemp, Jute, and other Fibers, Yarns, Threads, and Fabrics of the same, Straw Fabrics for Bonnets, Screens, and Mats, Webs and Cords of Reed, Cane, Bass, Hair, Wire, &c. Raw Silk, Spun Silk, and Manufactures of Silk, Silk Wastes. Small Ware Manufactures, Gold and Silver Cloths and Embroideries. Lace. Hosiery, milled and unmilled. Finished Objects of Clothing, (Clothes, Gowns, Hats, Bonnets, Shoes and Boots, Gloves and Linen, &c.) Upholstery, Carpeting, Curtains, Bed-Furniture, &c. Artificial Flowers and Feather Ornaments. Processes and Inventions used in the Production of these Manufactures. Statistics of Production.

(182.) FRANCIS WHITAKER & SONS, Saint Louis, Mo.—Preserved meats.

(183.) POMEROY & PLUMMER, New York.—Sixty pieces of fancy cassimeres and coatings.

(184.) MIDDLEPORT WOOLEN MILLS, Middleport, Ohio.—Fifteen pieces superior twenty-seven inch wide doeskin jeans.

(185.) Messrs. LE CLERQ BROTHERS, Gallipolis, Ohio.—Doeskin jeans.

(186.) THOMAS & Co., New York.—A variety of fine cassimeres, manufactured by the "New England Co.," Rockville, Connecticut.

(187.) JAMES Y. SMITH MANUFACTURING COMPANY, Providence, R. I.—Brown and bleached shirtings.

(188.) GARDNER, BREWER & Co., Boston, Mass.—Fine "G. B." shirtings, brown and bleached, manufactured by the Langdon Manufacturing Co., Manchester, New Hampshire.

(189.) LEAMAN, ABRAHAM & Co., New Orleans, La.—Cotton yarn, cotton thread, and cotton cloth.

(190.) ROGER E. HARDING, Saint Louis, Mo.—Cotton yarns.

(191.) ANDREAS HARTEL & Co., Philadelphia, Pa.—Calico.

(192.) STEARNS & FOSTER, Cincinnati, Ohio.—Three bales of cotton waddings and battings.

(193.) F. SACHSE & SON, Philadelphia, Pa.—Variety of shirts in American styles.

(194.) THE AMERICAN SUSPENDER COMPANY, New York.—Specimens of suspenders, frills, garters, garter and gusset webs.

(195.) S. N. MOODY, New Orleans, La.—Shirts.

(196.) MICHAELIS & KASKEL, New York.—Shirts, collars, cuffs, and underwear.

(197.) THALHEIMER & HIRSCH, Philadelphia, Pa.—Shirts.

(198.) MORITZ MAHLER, New York.—Fur sacques, patent and fancy muffs, boas, caps, and gloves.

(199.) JOHN ZALLIE, Saint Louis, Mo.—Frock-coat, beaver overcoat, spring sack-coat, pantaloons, and vest.

(200.) SCHAYER BROS., Boston, Mass.—Boots, shoes, and gaiters, and tanned alligator-skins. (Group VI.)

(201.) HENRY PROUSE COOPER, New York.—Dress-suit, frock-coat, driving and overcoats, morning-suit, waistcoats.

(202.) EDWARD FITZKI, Washington, D. C.—Ice-sandal and safety envelope. (Group XI.)

(203.) GRAY BROS., Syracuse, N. Y.—Ladies', misses', and children's shoes, machine-sewed.

(204.) CHICAGO CURTAIN FIXTURES COMPANY, Chicago, Ill.—Curtain fixtures.

(205.) W. & J. SLOANE, New York.—Three pieces Wilton and two pieces Axminster carpet.

(206.) A. LOWENBEIN, New York.—Furniture.

(207.) GOLDSCHMIDT, BACHRACH & Co., New York.—A variety of gloves cut and sewed by machinery.

(208.) Miss A. de ETTA BLOODGOOD, New York.—Studies of wax flowers and leaves.

(209.) Mrs. JOHN G. NEIL, Cambridge, Mass.—Wreaths of feathers of American birds.

(210.) Miss FANNY P. YOUNG, Baltimore, Md.—Excelsior system for cutting ladies' dresses.

(211.) HENRY LOEWENBERG, New York.—New fabric for cloth, leather, &c.

(212.) EDWIN C. BURT, New York.—Machine-sewed ladies' shoes.

(213.) TENNESSEE MANUFACTURING COMPANY, Nashville, Tenn.—Sheetings and drills.

(214.) FRED. J. KNAPP, New Orleans, La.—Dress goods from ramie fiber.

GROUP VI.—LEATHER AND INDIA-RUBBER INDUSTRY.

Leather, Articles of Leather, Harness, Saddles, Trunks, and other Leather Goods, (excluding Clothing and Fancy Goods;) Parchment and Goldbeaters' Skin. Skins and Furs, India-rubber and Gutta-Percha Articles, (excluding Philosophical and Mechanical Instruments, and parts of Machinery,) Water-proof Stuffs and Cloths. Processes and Inventions used in the Production of these Manufactures. Statistics of Production.

(215.) J. B. HOYT & Co., New York.—Three main belts for transmission of power. (Machinery Hall.) Samples of American leather.

(216.) ASSOCIATION OF LEATHER MANUFACTURE OF THE UNITED STATES, New York.—Specimens of leather and products of leather exhibited by the following firms, Nos. 204 to 220,* inclusive:

(217.) H. G. ELY & SANGER, New York.—Imitation goat.

(218.) SHULTZ, SOUTHWICK & Co., New York.—Sole-leather, Union crop, and hemlock.

(219.) KECK & MOSSEN, New York.—Sole-leather, Union crop.

(220.) BUCKLEY, LOCKWOOD, & Co., New York.—Sole-leather, Union crop.

(221.) HEALY, PLATT & Co., New York.—Sole-leather, hemlock.

(222.) G. B. HORTON & Co., New York.—Sole-leather, hemlock.

(223.) D. FRANTZ & SON, Louisville, Ky.—Sole-leather, oak.

(224.) ANTHONY P. BAER & Co., Baltimore, Md.—Sole-leather, oak.

(225.) FRANKLIN, UPTON & Co., Boston, Mass.—Sole-leather, oak backs.

(226.) CONRAD, FABEL & MOONEY, Louisville, Ky.—Sole-leather, oak.

(227.) J. B. HOYT & Co., New York.—Sole-leather, oak backs.

(228.) BUSH & HOWARD, Buffalo, N. Y.—Sole-leather, hemlock.

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(229.) J. F. SCHOELLKOPF & SON, Buffalo, N. Y.—Sole-leather, hemlock.

(230.) WISCONSIN LEATHER COMPANY, Milwaukee, Wis.—Harness-leather, hemlock; wax splits, hemlock; wax upper, hemlock.

(231.) BICKFORD, CURTISS, & DEMING, Buffalo, N. Y.—Oak belting, various widths, single and double.

(232.) J. H. & G. M. WALKER, Worcester, Mass.—Boots.

(233.) LILLY, YOUNG, PRATT & BRACKETT, Lynn, Mass.—Boots and shoes.

(234.) EDWARD SIMON & BROTHERS, Newark, N. J.—Trunks, traveling-bags, and gun-cases.

(235.) HEIM & ZIMMERMAN, New York.—Leather belting. (Machinery Hall.)

(236.) FORD & SHULZ, Saint Louis, Mo.—Patent tanned leather.

(237.) THOMAS SCHORR, New Orleans, La.—Four dozen assorted alligator-skins.

(238.) JUDSON L. THOMPSON, Syracuse, N. Y.—Water-proof goods.

(239.) C. L. HAUTHAWAY & SONS, Boston, Mass.—Leather dressings, &c.

(240.) REVERSIBLE BOOT-HEEL COMPANY, Providence, R. I.—Boot heels.

(241.) G. D. SIDWAY, Jackson, Miss.—Mexican saddle.

GROUP VII.—METAL INDUSTRY.

Goldsmiths' and Silversmiths' Work, and Jewelry, &c. Iron and Steel Wares, (excluding Machinery, Building Materials, Philosophical and Musical Instruments.) Manufactures from other Metals and Alloys. Weapons of every description, except Military Arms. Processes and Inventions used in the Production of these Manufactures. Statistics of Production.

(242.) EDWARD HENSHAW, Boston, Mass.—Shoe-tools and samples of shoe-pegs in boxes.

(243.) AULTMAN STEEL COMPANY, New York.—Hammers and hoe. (Machinery Hall.)

(244.) B. W. TUTHILL, New York.—Patent tubular metallic wheelbarrow.

(245.) W. B. SHERMAN, Boston, Mass.—Spades and shovels.

(246.) BARSTOW STOVE COMPANY, Providence, R. I.—Cooking-stove and portable range, with a hot-closet.

(247.) FRANK ADAM REIHER, Chicago, Ill.—Fire-proof iron shutter.

(248.) WM. RESOR & CO., Cincinnati, Ohio.—One "Monitor" cooking-stove, one "Red Cross" parlor-stove, both for bituminous coal.

(249.) GEORGE W. TOWER, Cambridgeport, Mass.—Cutting-off tool and dies, screw-plates for cutting bolts.

(250.) AMERICAN TACK COMPANY, Boston, Mass.—Samples of tacks, brads, &c.

(251.) THE BILLINGS & SPENCER MANUFACTURING COMPANY, Hartford, Conn.—Drop forgings of wrought iron and steel for machinery generally. Solid forgings and shuttle for all kinds of sewing-machines.

(252.) MORRIS, WHEELER & Co., Philadelphia, Penn.—Iron nails cut by machinery.

(253.) JOHN D. FARRINGTON, jr., New York.—Cuspadores and umbrella lock-stands.

(254.) CHARLES CHURCHILL, New York.—Stevens's patent parallel vise, with swivel, taper, table, and pipe attachments.

(255.) E. S. MOULTON, Chelsea, Mass.—Pipe-tongs.

(256.) SWEET, BARNES & Co., Syracuse, N. Y.—Mowing-knives and reaper-sickles.

(257.) MORRIS AXE AND EDGE-TOOL COMPANY, Baldwinsville, N. Y.—Axes, adzes, hatchets, &c.

(258.) HALL'S SAFE AND LOCK COMPANY, Cincinnati, Ohio.—Fireproof safe, burglar-proof safe, fire and burglar proof safe, fifteen varieties of combination locks.

(259.) CHARLES CHURCHILL, New York.—Patent twisted drills for iron, steel, &c.

(260.) CHARLES CHURCHILL, New York.—Universal lathe-chucks and drill-chucks.

(261.) ARISTIDE GERARD, New Orleans, La.—Safety letter-box.

(262.) AMERICAN STAIR-ROD COMPANY, New York.—Stair-rods.

(263.) PETERS BROTHERS, New York.—Tailors' shears, of R. Heinriche's Sons' patent, Newark, N. J.—Domestic knives and scissors.

(264.) G. & S. BLODGETT & Co., Burlington, Vt.—Portable oven. ("*Hors concours.*")

(265.) THOMAS HAGGERTY, Jersey City, N. J.—Sad-iron heated by gas.

(266.) J. N. DOUGLAS, Belleville, Ill.—Nails of assorted sizes.

(267.) LANDERS, FRARY & CLARK, New Britain, Conn.—One set of carvers.

(268.) DOANE & WELLINGTON, New York.—Portable gas-fixtures, variety of pendants, bracket-lamps, and vapor jet-burner.

(269.) JOHN GROSSIUS, Cincinnati, Ohio.—Patent ventilating schoolhouse stove.

(270.) THE ATLAS IRON COMPANY, Pittsburgh, Penn.—Iron ingot-molds, hammer-dies, bars of cast iron, specimens for testing.

(271.) E. H. BARNEY, Springfield, Mass.—Nine pairs of gold, silver, and nickel plated and blued skates; the Barney and Berry's patent club and rink skates.

(272.) JOHN GROSSIUS, Cincinnati, Ohio.—Universal meat-broiler.

(273.) DUNBAR, HOBART & WHIDDEN, South Abington, Mass.—Card of tacks and nails.

(274.) A. FIELD & SONS, Taunton, Mass.—Card of tacks and nails.

(275.) AUSTIN G. DAY, New York.—"Kerite" insulated telegraph

wires, unaffected by the action of cold or warm liquids, oils, weak acids, or gas.

(276.) J. B. WEST, Genesee, N. Y.—Improved lathe-dog.

(277.) WESTFIELD LOCK WORKS, Westfield, N. Y.—Variety of door-locks, in use on the United States Mint; self-registering padlocks, used in the United States Revenue Department; and mail-locks, employed in the postal service of the Canadian government.

(278.) SARGENT, GREENLEAF & COLE, New York.—Variety of patent adjustable stove-pipe elbows.

(279.) SAMUEL STRONG, Washington, D. C.—Letter-boxs adopted by the United States Government for public and private use.

(280.) RUSSELL & ERWIN MANUFACTURING COMPANY, New Britain, Conn.—Sample card of bronze hardware.

(281.) ALBERT M. ENDWEISS, Leavenworth, Kans.—Quarter-second fly-back watch, with only five wheels instead of eleven, as usual.

(282.) O. LINDEMAN & Co., New York.—Bird-cages.

(283.) THE DEVOE MANUFACTURING COMPANY, New York.—Cans with tops of various patterns; samples of oil. (Group III.)

(284.) CLEVELAND NON-EXPLOSIVE LAMP COMPANY, Cleveland, Ohio.—Variety of lamps and oil-cans, with cuts and sections of same.

(285.) WALTON BROTHERS, Newark, N. J.—Railway-lamps.

(286.) IVES PATENT LAMP COMPANY, New York.—Fifteen varieties of hall, bracket, and hanging lamps, chandeliers, lanterns, and lamp-fixtures, globes, chimneys, &c.

(287.) KEITH NICKEL-PLATING COMPANY, New York.—Samples of nickel-plating on various metals.

(288.) THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.—Crucibles made from American graphite.

(289.) STANLEY RULE AND LEVEL COMPANY, New Britain, Conn.—Sixteen iron-planes, thirteen wood-planes, and two "T" bevels.

(290.) JOHN H. BURLESON, New York.—Hubbard's patent wheel-skates.

(291.) JAMES W. BARTLETT, New York.—Patent street-lamp.

(292.) S. P. BURDICK, New York.—Patent screw-bolt.

(293.) LOOBY & MITCHELL, Taylor's Depot, Miss.—Files.

(294.) G. GUNTHER, New York.—Bright-metal and silver-plated cages.

(295.) DOUGLAS AXE MANUFACTURING COMPANY, Boston, Mass.—Axes.

(296.) F. W. NICHOLS, Boston, Mass.—Self-supporting hinges.

GROUP VIII.—WOOD INDUSTRY.

Cabinet Work, (Inlaid Floors, Windows, Doors, &c.) Joiner's Work Cleft Woodwork, (Casks, Shingles, Sieves, &c.) Small Staves and their Products, Matches, &c. Veneers and Marquetries, Cut and Turned Wood. Chisel Work and Carved Work. Cork Manufactures. Basket Work. Woodwork Painted, Stained, and Gilt. Processes and

Inventions used in the Production of these Manufactures. Statistics of Manufacture.

(297.) WILLIAM T. LAYAUX, New Orleans, La.—Cosmopolitan bedstead.

(298.) GEORGE W. HOWE, Cleveland, Ohio.—Patent vent and bung.

(299.) MITCHELL & RAMMELSBERG FURNITURE COMPANY, Cincinnati, Ohio.—Bedstead, dressing-case and table, and extension dining-table.

(300.) WILLIAM W. SKAATS, Cincinnati, Ohio.—The "Perfection" spring-bed, with a combination of springs and wire netting, adapted for use in car-seats, sofas, chairs, &c.

(301.) C. A. SCHMIDLER, New York.—Patent piano-stool.

(302.) PAPE BROTHERS & KUGEMAN, Cincinnati, Ohio.—Specimens of lacquered, silver-gilt, and black-walnut moldings, and imitations of fine wood moldings.

(303.) S. HALL'S SON & CO., New York.—Patent pulley-blocks.

(304.) GEORGE W. KNOX, Cleveland, Ohio.—Case of whittlings, army mementoes.

(305.) GEORGE S. MCGREGOR, Cleveland, Ohio.—Imitations of oak, rosewood, mahogany, and French and American walnuts.

(306.) JOHN G. DAVIS & SONS, Philadelphia, Pa.—Carriage-wheels.

(307.) CHARLES KIESELE, New Haven, Conn.—Ladies' dressing and sewing case.

GROUP IX.—STONE, EARTHENWARE, AND GLASS INDUSTRY.

Stones, Natural and Artificial. Slate and Cement Works, Natural and Imitated Stones and Marbles, Paving-Stones and Floor-Tiles, Ornaments and Decorations, Pipes, Grinding-Stones, &c. Earthenware, Pipes, Cooking-Vessels, Stoves, Plastic Productions, Terra-Cottas, &c. Glass Manufactures: Glass for Household Use and Fancy Purposes, Imitation Gems and Pearls unset, &c. Processes and Manufactures used in the Production of the above Articles. Statistics of Production.

(308.) BURLINGTON MANUFACTURING COMPANY, Burlington, Vt.—Specimens of Vermont statuary marble.

(309.) LACLEDE FIRE-BRICK COMPANY, Saint Louis, Mo.—Fire brick and clay.

(310.) JOHN M. MUELLER, Cincinnati, Ohio.—Sandstone, rough and carved.

(311.) J. E. MITCHELL, Philadelphia, Pa.—Thirteen varieties of grindstones, unmounted; three mounted grindstones.

(312.) J. MCDERMOTT & CO., Cleveland, Ohio.—Grindstones from Berea, Ohio; variety of building-stones.

(313.) TEMPEST, BROCKMAN & CO., Cincinnati, Ohio.—A variety of flints, clays, feldspars, &c., with specimens of earthenware.

(314.) JOHN J. SCHILLINGER, New York.—Artificial stone. Four hundred square feet of cement pavement laid at the western end of the covered passages leading from the bureau of the Imperial Commission.

(315.) SIMPSON & CHASE, New York.—Oil-stones.

(316.) MICHAEL HARRIS, San Francisco, Cal.—California marble.

(317.) CHARLES TREMAINE, Manlius, N. Y.—Gypsum and hydraulic cement.

(318.) C. E. HOLDEN, Mineral Point, Ohio.—Fire-brick, fire-clay, fire-clay calcined.

(319.) PETER COLLIER, Burlington, Vt.—Specimens of Vermont marble and granite.

(320.) WILLIAM R. HANSOM & SON, Philadelphia, Pa.—Specimens of variegated Champlain marble from Mallet's Bay, Vermont.

(321.) THE CHICAGO TERRA-COTTA COMPANY, Chicago, Ill.—Terra-cotta wares.

(322.) UNION SIGN WORKS, Saint Louis, Mo.—Specimens of painting and ornamental work on glass.

(323.) CHARLES C. BRENNER, Louisville, Ky.—Illuminated glass signs.

(324.) SYDNEY H. WESTON, Burlington, Vt.—One barrel lime.

(325.) WILLIAM STRUTHERS & SONS, Philadelphia, Pa.—A variety of cut marbles.

(326.) GEORGE M. SMITH, Rochester, N. Y.—Statues, pedestals, and medallions finished in "carbonite."

GROUP X.—SMALL WARE AND FANCY GOODS.

Manufactures of Ivory, Meerschaum, Tortoise-Shell, Mother-of-Pearl, Whalebone, Wax Wares, Japanned Goods, &c. Fancy Goods of Leather, Bronze, &c. Umbrellas, Parasols, Fans, Canes, Whips, &c. Combs and Brushes, &c. Toys. Processes and Inventions used in the Production of Manufactures. Statistics of Production.

(327.) FREDERICK SCHNEIDER, Saint Louis, Mo.—Merchant bill-books and pocket-books.

(328.) FREDERICK WALKER, New York.—Hickory walking-canes.

(329.) J. HERZBERG & BROTHERS, Philadelphia, Pa.—Umbrella.

(330.) JOHN MENDLING & CO., New Orleans, La.—Broom-corn clothes-brushes, broom-corn whisks.

(331.) JAMES M. C. Martin, New York.—Brushes.

(332.) STEVENS & BROWN MANUFACTURING COMPANY, Cromwell, Conn.—Variety of mechanical toys, forty pieces.

(333.) D. B. FELTER, New Brunswick, N. J.—Lenhart's patent toy air-rifle and pistol.

(334.) Mrs. EMILY CLEMENS, London, England.—Scientific toys, illustrating the power of electricity and steam.

(335.) VERMONT NOVELTY WORKS, Springfield, Vt.—Toy carriages and [illegible]ulators.

(336.) BENJAMIN F. SMITH, New Orleans, La.—Cane or bamboo water and gas pipes, improved furnace and steam-generator, cane spring-bed bottoms and life-preserver.

GROUP XI.—PAPER INDUSTRY AND STATIONERY.

Paper Pulp, Paper, and Pasteboard. Colored Papers, Paper-hangings, Tapestry, Playing-cards, &c. Papier-Maché Goods, Card and Mill Board. Articles for Writing, Drawing, and Painting. Book-binding and Similar Work. Processes and Manufactures used in the Production of the above Manufactures. Statistics of Production.

(337.) LOUISIANA PAPER MANUFACTURING COMPANY, New Orleans, La.—Paper manufactured from palmetto and the ramie plants, grown in the State.

(338.) COHN, LEIBLICH & Co., New York.—Specimens of paper-hangings in imitation of wood.

(339.) AMERICAN PAPIER-MACHÉ COMPANY, New York.—Chambers, water and milk pails, fire, deck, and army buckets, wash-bowls and pitchers, cuspadores, office and parlor spittoons, mats, pails, earth-closet pails, doll-heads, and toys.

(340.) JOSEPH SCHEDLER, Jersey City Heights, N. J.—Terrestrial and celestial globes.

(341.) LEROY M. FAIRCHILDS & Co., New York.—Gold pen and pencil cases, gold pens, gold-mounted rubber pen and pencil cases.

(342.) CHARLES MOSER & Co., Cincinnati, Ohio.—Colors in tubes for artists' use.

(343.) JOSEPH FROMHERZ, Cincinnati, Ohio.—Writing-fluids, copying-inks, &c.

(344.) JAMES MORTON, New York.—Gold pens and holders.

(345.) EPHRAIM JOHNSON, New York.—Gold pens.

(346.) JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.—Variety of pencils manufactured from American graphite.

(347.) JANENSKY & Co., Philadelphia, Pa.—Artists' materials.

(348.) THEODORE BERGNER, Philadelphia, Pa.—Improved parallel ruling and section-lining instrument, two improved drawing-boards with parallel motion and new mode of fastening the paper, assortment of syphon-cups for preserving India-ink and colors in a fluid state.

(349.) JOHN HOLLAND, Cincinnati, Ohio.—Gold pens and holders.

(350.) SANDFORD & Co., Cleveland, Ohio.—Bound commercial account books.

(351.) ALTEMUS & Co., Philadelphia, Pa.—Photograph-albums.

(352.) R. & T. A. ENNIS, Saint Louis, Mo.—Blank books.

(353.) M. K. KELLOGG, New York.—Patent frame-stretcher.

GROUP XII.—GRAPHIC ARTS AND INDUSTRIAL DRAWING.

Book-printing. Xylography. Copper-plate and Steel-plate Printing. Lithography and Chromo-lithography. Photography. Engraving and

Guilloche-work. Pattern-drawing and Drawing for Decoration. Tools and Apparatus. Statistics of Production.

(354.) L. GRAHAM, New Orleans, La.—Specimens of job printing and of ornamental printing.

(355.) R. & T. A. ENNIS, Saint Louis, Mo.—Specimens of printing.

(356.) W. KURTZ, New York.—Plain and colored photographs on paper and porcelain.

(357.) HUGH LEWIS, New Orleans, La.—Maps of Louisiana and Mississippi and miscellaneous lithographic work.

(358.) NATIONAL BANK-NOTE COMPANY, New York.—Frame of bank-note engraving and printing.

(359.) L. PRANG & CO., Boston, Mass.—Chromo-lithographs.

(360.) DOMESTIC LITHOGRAPHIC AND PRINTING COMPANY, Saint Louis, Mo.—Specimens of lithographic printing and engraving.

(361.) DUVAL & HUNTER, Philadelphia, Pa.—Chromo-lithographs.

(362.) HOMER, LEE & CO., New York.—Specimens of cards, monograms, &c.

(363.) BUREAU OF ENGRAVING AND PRINTING, Treasury Department, Washington, D. C.—Engravings.

(364.) ROWLEY & CHEW, Philadelphia, Pa.—Specimen of color-printing.

(365.) W. SCHWIND & E. KREUGER, New York.—Contact-prints or life-size photographs.

(366.) WILLIAM R. HOWELL, New York.—Photographs.

(367.) B. & G. MOSES, New Orleans, La.—Photographs.

(368.) C. HOHLENBERG, New York.—Album of photographs.

(369.) LEON VAN LOO, Cincinnati, Ohio.—Variety of imperial and cabinet photographs, portraits, and genre-groups from life.

(370.) JAMES LANDY, Cincinnati, Ohio.—Rembrandt photographs.

(371.) THEODORE LILIENTHAL, New Orleans, La.—Photographic views.

(372.) HENRY RICHMAN, Cincinnati, Ohio.—Microscopic photographs.

(373.) CHARLES BIERSTADT, Niagara Falls, N. Y.—Stereoscopic views of Niagara Falls and California scenery.

(374.) E. & H. T. ANTHONY & CO., New York.—Stereoscopic views.

(375.) HENRY ROCHER, Chicago, Ill.—Photographs.

(376.) THOMAS T. SWEENEY, Cleveland, Ohio.—Photographs.

(377.) JOSEPH M. HIRSH, Chicago, Ill.—Chemical etchings and engravings, photo-engravings on metals, chemical sculpture.

(378.) GAVIT & CO., Albany, N. Y.—Engravings.

(379.) EMIL P. SPAHN, Newark, N. J.—Photographic camera and attachments.

(380.) EMMET DINSMORE, Meadville, Pa.—Sholes' type-writer; a machine for writing by pressing on a bank of keys.

(381.) ALEXANDER BECKERS, New York.—Table stereoscope in rosewood, for 150 glass or 300 paper stereoscopic views.

(382.) E. & H. T. ANTHONY, New York.—Camera-boxes, camera-stands, iron plates for photographs, stereoscopes, chemicals.

(383.) GEORGE BRUCE'S SON & Co., New York.—Book of types.

(384.) JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J.—Variety of graphites for electrotyping, &c.

(385.) OSCAR H. HARPEL, Cincinnati, Ohio.—Harpel's typograph or book of specimens.

MACHINERY DEPARTMENT.—AGRICULTURAL MACHINERY HALL, MACHINERY HALL, AND PARK.

GROUP XIII.—AGRICULTURAL AND GENERAL MACHINERY.

Prime Movers, (Steam-Generators, Steam-Engines, Water-Wheels, Turbines, Pressure-Engines, Air, Wind, and Electro-Magnetic Engines, Gas Machines.) Machines for Transmitting Power, (Shafts, Wheels, Pulleys, Bands, &c.) Machines for Working Special Kinds of Materials, (Machines for Mining, Metallurgy, Metal Work, and Wood Work; Machines for Spinning, Weaving, Knitting, Sewing and Embroidering; Machines for Fulling, Cleansing, Shearing, Dyeing; Machines for Bleaching, Leather-Dressing, &c.; Machines for Paper Manufactures and Book-binding, for Type-Founding, Printing, Lithography, Copper-plate Printing, Color Printing, &c.; Machines and Apparatus for Sugar-Making, Oil Manufacture, Breweries, Distilleries, Stearine, Soap, Candles, Starch, Ice-Making, Match-Making, Corn-Mills, and Agricultural Machinery and Apparatus.) Other Machinery not belonging to the above mentioned, (Blast-Engines, Fire-Engines, Pumps, Ventilators, &c.) Materials and Parts of Machinery. Railway Machinery, (Locomotives, Tenders, Railway Velocipedes and parts of them, Railway Carriages and parts composing them, Special Machinery and Apparatus for Railway Workshops and Railway Contrivances; for making and maintaining Railway Plant; Snow Plows, &c.) Steam Gauges, Dynamometers, Tradiometers, &c. All sorts of Vehicles not concerned with Rail. Statistics of Production.

(386.) THE MARSH HARVESTER MANUFACTURING COMPANY, Sycamore, Ill.—Sulky corn-plow and cultivator.

(387.) DEERE & Co., Moline, Ill.—Three "old-ground" or stubble plows of cast steel, one prairie-sod or breaking plow of cast steel, one cultivator for maize.

(388.) MARSH, STEWARD & Co., Plano, Ill.—Harvester.

(389.) JOSEPH GEEMANN, New York.—Malt-kiln, grain-dryer, and malt-sprouter.

(390.) J. B. WEST, Genesee, N. Y.—Horse-rake.

(391.) CHADBORN & COLDWELL MANUFACTURING COMPANY, Newburgh, N. Y.—Hand lawn-mower.

(392.) H. H. MUNROE, White Plains, N. Y.—Rotary harrow.

(393.) THOMAS LUDLOW & RODGERS, Springfield, Ohio.—Two-horse grain and seed drill.

(394.) W. D. BURRALL, Waterloo, N. Y.—Burral's Patent Iron Corn-Sheller and Separator.

(395.) D. M. OSBORNE & Co., Auburn, N. Y.—Mowing-machine, reaping-machine, with automatic rake, combined mower and reaper, with automatic rake.

(396.) SPRAGUE MOWING-MACHINE COMPANY, Providence, R. I.—Mowing-machines.

(397.) WHEELER MELICK COMPANY, Albany, N. Y.—Wheel horse-rake.

(398.) TRENTON AGRICULTURAL WORKS, Trenton, N. J.—One two-horse railway tread power, one thrashing and cleaning machine.

(399.) PHILLIPS SPIRAL CORN-HUSKER COMPANY, Hudson, N. Y.—Corn-husker.

(400.) SUPERIOR MACHINE COMPANY, Wheeling, W. Va.—Mowing-machine.

(401.) HENRY L. HALL, Chicago, Ill.—Model of combined seed-sower and cultivator.

(402.) COLLINS & Co., New York.—Three "Eclipse" gang-plows, four plows of cast cast-steel.

(403.) JOHN M. CARR, New Orleans, La.—American transplanter.

(404.) WALTER ABBOTT WOOD, Hoosick Falls, N. Y.—One reaping-machine, chain-rake plan; one reaping-machine, sweep-rake plan; one reaping-machine with automatic binder; three two-horse mowing-machines.

(405.) THROOP'S GRAIN-CLEANING COMPANY, Syracuse, N. Y.—Smut and separating machines.

(406.) J. F. SIEBERLING COMPANY, Akron, Ohio.—Mower, mower and reaper combined with dropping attachments, mower and reaper combined with self-rake attachments.

(407.) WARDER, MITCHELL, & Co., Springfield, Ohio.—Champion mower, Champion reaper, with self-rake attachment.

(408.) AULTMAN, MILLER & Co., Akron, Ohio.—Senior and junior Buckeye mowers, Buckeye mower with self-raking reaper attachment, Buckeye mower with Miller's table-rake reaper attachment.

(409.) JOHNSTON HARVESTER COMPANY, Broekport, N. Y.—Mower, self-raking reaper, combined self-raking reaper and mower.

(410.) ADDRIANCE, PLATT & Co., New York.—Buckeye mower, Buckeye mower and reaper, self-raking.

(411.) J. G. HESTER, Raleigh, N. C.—Self-acting gate.

(412.) NEW YORK PLOW COMPANY, Newark, N. J.—Two harrows, two plows, variety of plowshares.

(413.) HILL ARCHIMEDEAN LAWN-MOWER COMPANY, Hartford, Conn.—Lawn-mowers.

(414.) CYRUS H. MCCORMICK, Chicago, Ill.—Mower and reaper, &c.

(415.) CINCINNATI STEAM-ENGINE AND HYDRAULIC WORKS, Cincinnati, Ohio.—Bran-duster (used in manufacture of flour.) (*Hors Concours.*)

(416.) A. Berg & Co., Cincinnati, Ohio.—Copper alcohol distillery.

(417.) John Raddin, Lynn, Mass.—Elastic wheels for tramway cars and carriages.

(418.) Electro-motor and Battery Company, Brooklyn, N. Y.—Electric battery and electro-motor attached to a sewing-machine.

(419.) George Bayley Brayton, Boston, Mass.—High-pressure gas-engine.

(420.) Pickering & Davis, Portland, Conn.—Steam-engine and regulators.

(421.) Capron Water-wheel Manufacturing Company, Hudson, N. Y.—Turbine water-wheel.

(422.) Joseph Proctor, Baltimore, Md.—Spring motor for propelling sewing-machines and other light machinery.

(423.) New York Safety Steam-Power Company, New York.—Two vertical steam-engines, one of ten and one of four-horse power, for use in the American department of the Exhibition.

(424.) Norwalk Iron Works, South Norwalk, Conn.—One steam-engine of twenty-five horse-power and steam-pumps for use in the American department of the Exhibition.

(425.) Baxter D. Whitney, Winchendon, Mass.—One band-saw machine, one machine for sawing barrel-staves, one machine for sawing pail staves, one pattern saw-bench, one balanced reciprocating scroll-saw, one pail-turning machine, one cylinder-planer, one gauge-lathe, one smoothing-machine, one knife-grinder, one double boring-machine.

(426.) Charles Maurice, New York.—Autographic printing cylinder for offices. (Court-yard.)

(427.) Henry Redlich, Chicago, Ill.—Machine for capping bottles with tin foil.

(428.) John Mathews, New York.—Soda-water apparatus.

(429.) Pratt & Whitney Manufacturing Company, Hartford, Conn.—One ten-inch pillar shaper, one gang of drill spindles, one screw-machine with wire feeder, one screw-machine with chasing apparatus, milling-machines, cutter and spindle grinding-machines, two thirteen-inch engine-lathes.

(430.) Empire Wringer Company, Auburn, N. Y.—Empire wringer.

(431.) Albin Warth, Stapleton, N. Y.—Machine for cutting clothing by steam-power.

(432.) Brown & Sharpe Manufacturing Company, Providence, R. I.—Two universal milling-machines, with gear-cutting device, four screw-machines, one plain and one small milling machine, section of an improved work-bench.

(433.) J. A. Fay & Co., Cincinnati, Ohio.—Patent band-sawing, scroll-sawing, mortising, boring, and tenoning machines.

(434.) George W. Howe, Cleveland, Ohio.—Knitting-machine.

(435.) The Howe Machine Company, New York.—Sewing-machines and samples of work.

(436.) JOHN VAN DUSSEN REED, New York.—Circular loom for weaving irregular shapes, as hats, caps, bonnets, &c.

(437.) JOHN G. AVERY, Spencer, Mass.—Wool-spinner.

(438.) THE SINGER MANUFACTURING COMPANY, New York.—Sewing-machines and samples of work.

(439.) WHITNEY SEWING-MACHINE. Paterson, N. J.—Sewing-machines.

(440.) M. WILLIAMS, New York.—Johnson's patent embroiderer.

(441.) WHEELER & WILSON SEWING-MACHINE COMPANY, New York.—Sewing-machines, button-hole machine, attachments and cases of samples.

(442.) H. C. COVERT, New York.—Woodbury brush-making machine.

(443.) METROPOLITAN WASHING-MACHINE COMPANY, New York.—Doty's washing-machine, universal clothes-wringer.

(444.) WILSON SEWING-MACHINE COMPANY, Cleveland, Ohio.—Sewing-machines and samples of work.

(445.) JOHN WHITEFORD, Wyandotte, Kan.—Patent self-coupler for freight-cars. The Kansas brick-machine, carrying clay in a hopper and molding and depositing bricks as it is drawn across the yard.

(446.) MERRIT GALLEY, Rochester, N. Y.—Stereotyping-machine.

(447.) MERRIT GALLEY, Rochester, N. Y.—Power printing-press.

(448.) WILCOX & GIBBS SEWING-MACHINE MANUFACTURING COMPANY, New York.—Sewing-machines.

(449.) OZRA MORRILL & Co., Derby Line, Vt.—Sewing-machines.

(450.) ARMSTRONG & HOUSE MANUFACTURING COMPANY, Bridgeport, Conn.—Knitting machines.

(451.) PROVIDENCE TOOL COMPANY, Providence, R. I.—Clothes-wringer and benches.

(452.) LAMB KNITTING-MACHINE COMPANY, Chicopee Falls, Mass.—Eight varieties of hand knitting-machines.

(453.) ROBERT H. COLLYER, South Lambeth Road, London, England.—Machinery for cleaning flax and hemp. Adapted to all grades of light and heavy work.

(454.) WILLIAM SELLERS & Co., Philadelphia, Pa.—One rotary puddling-machine, one twelve-inch rolling-mill train, bed-plates, pinion-housings and pinions, lathe and planing-machine for iron, gear-cutting machine, bolt-threading machine, slotting-machine, drill-grinding machine, shafting and connections; two self-adjusting injectors, one self-adjusting injector with variable tubes.

(455.) GEORGE W. HOWE, Cleveland, Ohio.—Sewing-machines.

(456.) WITHERBY, RUGG & RICHARDSON, Worcester, Mass.—Planing, grooving, tonguing, tenoning and other wood-working machines.

(457.) CHARLES CHURCHILL, New York.—Drilling-machines.

(458.) JOHN BAYLIS, New York.—One vertical hot-blast and water tuyere and forge.

(459.) REVERSIBLE BOOT-HEEL COMPANY, Providence, R. I.—One

patent machine for filling heels, flasks, and patterns for casting shells, molds for rubber heels; castings and an assortment of heels; boots and shoes with patent heels.

(460.) B. C. TILGHMAN, Philadelphia, Pa.—Machine for cutting stone by means of a stream of sand, propelled by a jet of high-pressure steam; machine for cutting and engraving glass by sand propelled by a current of air; specimens of work done by the "sand-blast process."

(461.) KNAPP DOVETAILING-MACHINE COMPANY, Northampton, Mass.—Dovetailing-machine, designed especially for cabinet and other fine work.

(462.) THOMAS HALL, Northampton, Mass.—Patent parallel bench-vises, adjusted instantly, and by one motion; placed on an automatic swivel, the grip of the vise holding it firmly in any position.

(463.) G. N. BACON & CO., London, England.—Sewing-machine.

(464.) THE MOWRY AXLE AND MACHINE COMPANY, Genesee, N. Y.—West's American tire-setter.

(465.) STILES & PARKER PRESS COMPANY, Middletown, Conn.—One Stiles's patent power punching-press, geared, one Stiles's patent power punching-press, not geared, one Parker's patent power punching-press, one Stiles's patent drop press, with 100-pound hammer.

(466.) LESTER E. ROSS, Providence, R. I.—Independent picker motion for cotton, wool, linen, and silk looms driven by Allen's friction clutch pulley. In process of weaving print goods, (calicoes.)

(467.) R. BALL & CO., Worcester, Mass.—One "Woodworth" planer, one molding-machine, one tenoning-machine, three mortising-machines, one dovetailing-machine, one double saw-machine, one irregular molder.

(468.) LATHE & MORSE TOOL COMPANY, Worcester, Mass.—One lathe and one planer.

(469.) HORACE H. BIGELOW, Worcester, Mass.—One heel-compressing-machine, one attaching and one cutting machine with dies, one "Rand" cutting and splitting machine, one heel-building machine, Rand's turning and tacking machine, one heel-filling machine.

(470.) TOWER & CLAASSEN, Canton, Ohio.—One quarto-medium chromatic printing-press.

(471.) H. E. TOWNSEND, Boston, Mass.—One screw-wire nailing-machine, one screw-wire tacking-machine, one screw-wire channeling-machine, three sewing-machines, one pegging-machine, two eyelet-machines, one splitting-machine, one rolling-machine, one burnisher.

(472.) SAMUEL A. MILLER, Cincinnati, Ohio.—Two hand-machines for making stove, drain, and other pipe-elbows from one piece of sheet-metal.

(473.) WEED SEWING MACHINE COMPANY, Hartford, Conn.—Sewing-machines and samples of work. Three new "G. F." machines, with a new and effective stop-motion.

(474.) JUDSON L. THOMPSON, Syracuse, N. Y.—Tobacco stripping and booking machine.

(475.) WINN & MYTINGER, Philadelphia, Pa.—Patent non-combined brick-machine, designed for stationary steam-power; model (¼ size) of patent portable brick-machine, combining locomotive-engine, boiler, and brick-machine.

(476.) THE SECOR SEWING-MACHINE, New York.—Sewing-machines.

(477.) JOHN L. POPE, Cleveland, Ohio.—Machine for tapping or threading steam-fittings.

(478.) FRANK S. ALLEN MANUFACTURING COMPANY, New York.—Allen & Ritchel serial crank-drilling and boring machine.

(479.) EMPIRE WIND-MILL MANUFACTURING COMPANY, Syracuse, N. Y.—Model of wind-mill.

(480.) THEO. A. DODGE, Cambridge, Mass.—One McKay sole-sewing-machine, one turned shoe-sewing-machine, three channeling-machines, spoolers and waxers, heeling-machine, edge-trimming and setting-machine.

(481.) C. B. ROGERS & CO., Norwich, Conn.—One double-surface planing and matching machine, one four-sided molding machine, one four-sided molding-machine (small,) one double head and cape tenoning-machine, one sash sticking-machine, one hub mortising-machine, six saw arbors, (various sizes,) one grooving saw arbor.

(482.) W. & B. DOUGLAS, Middletown, Conn.—Variety of pumps, hydraulic rams, garden engines, and other hydraulic machinery.

(483.) ALBERT H. EMERY, New York.—Hydraulic, hay, warehouse, counter, and chemists' scales.

(484.) COWING & CO., Seneca Falls, N. Y.—American driven wells, and materials used in sinking the same.

(485.) CHARLES CHURCHILL, New York.—Suction and force pumps for hand and power.

(486.) CHARLES CHURCHILL, New York.—One American steam fire-engine made by the "Silsby Manufacturing Company, Seneca Falls, New York."

(487.) BABCOCK FIRE EXTINGUISHER COMPANY, Chicago, Ill.—Portable fire-extinguisher.

(488.) WILLIAM BURDON, Brooklyn, N. Y.—Steam vacuum-pump.

(489.) COWING & CO., Seneca Falls, N. Y.—One hundred and fifty varieties of pumps and hydraulic engines, comprising suction, lift, and force pumps, single and double acting for hand and power, ale and hot-liquid pumps, test and pressure pumps for plumbers' and boiler-makers' use, hydraulic rams and engines.

(490.) BRIDGEPORT MANUFACTURING COMPANY, Bridgeport, Conn.—The "American submerged" pump, suction and force pumps for ships and engines, driven wells, and fire-engines.

(491.) WILLIAM LEDGARD ELLSWORTH, Brooklyn, N. Y.—Etna portable fire-extinguisher.

(492.) THOMAS B. FOGARTY, Warren, Mass.—"Excelsior" portable gas-machine, with capacity for 100 burners.

(493.) P. H. & F. ROOTS, Connersville, Ind.—Rotary blowing-engines nd portable forges.

(494.) WILLIAM L. GREGG, Chicago, Ill.—Model of excelsior brick-ress.

(495.) ADAM CARR, New York.—One plunger-pump, for mines and oal-works.

(496.) GEORGE B. BOOMER, Syracuse, N. Y.—Patent paper-press, ower 200 tons; patent lard or wine press, power 100 tons.

(497.) WILLIAM B. WATKINS, Jersey City, N. Y.—Improved automa-ic fire-extinguisher and signal-alarm, and mode of operating same by ction of heat.

(498.) AUSTIN H. SMITH, Brooklyn, N. Y.—Hydraulic stone-breaker.

(499.) HENRY RICHMAN, Cincinnati, Ohio.—Improved steam-trap.

(500.) SCHWILL & DUBRAL PORTABLE FORGE COMPANY, Cincinnati, Ohio.—Portable forge.

(501.) H. L. BREVOORT, New York.—Patent condenser.

(502.) NATHAN & DREYFUS, New York.—Lubricators, oil-cups, and valves.

(503.) JONES & LAUGHLIN, Pittsburgh, Pa.—Cold-rolled shafting for use in American department, and for testing. Hangers, couplings, and pulleys for same.

(504.) PARK BROS. & Co., Pittsburgh, Pa.—Samples of cast-steel boiler-plate, "hot-flanged," "bent cold," shearings, &c., for tests, section of a soft-steel railway axle.

(505.) VOLNEY W. MASON & Co., Providence, R. I.—Friction clutch pulleys, with shaft, stand, and strapper.

(506.) PITKIN BROS., Hartford, Conn.—Forty horse-power cylindrical tubular boiler, for supplying steam to the American department.

(507.) AMERICAN CLUTCH COMPANY, Middletown, Conn.—Friction clutch pulleys, applicable to railway brakes and lines of shafting.

(508.) CHARLES HENRY BAKER, Philadelphia, Pa.—A set of six self-gauging tuyeres of fire-brick, for use in the Bessemer process of making steel.

(509.) A. D. EVANS, Boston, Mass.—Shuttles covered with prepared raw-hide, for use in cotton and woolen mills.

(510.) HUBBARD & CURTIS MANUFACTURING COMPANY, Middletown, Conn.—Patent drill-chucks.

(511.) FRANK OLDS, Syracuse, N. Y.—Steam-engine governors.

(512.) E. HORTON & SON, Windsor Locks, Conn.—Lathe-chuck for boring or turning.

(513.) JAMES WALSH, jr., Philadelphia, Pa.—Steam-valve without packing, applicable to steam and water connections, one improved hydrant cock.

(514.) MORSE TWIST DRILL COMPANY, New Bedford, Mass.—Patent increase twist drills, sockets, solid reamers, shell reamers, Beach's patent self-centering and self-tightening drill-chucks, center drill-chucks.

(515.) F. LUNKENHEIMER, Cincinnati, Ohio.—Oil-cup and lubricator for locomotive cylinders.

(516.) POST & Co., Cincinnati, Ohio.—Assortment of passenger-car-riage trimmings: side and center lamps, locomotive head-light burner; steam-gauge, and cut and engraved glass.

(517.) JOHN STEPHENSON & Co., New York.—One street-car.

(518.) VOSE, DINSMORE & Co., New York.—Variety of patent railway car-springs.

(519.) ROYER WHEEL COMPANY, Cincinnati, Ohio.—Wheels, spokes, and hubs.

(520.) RAMAPO WHEEL AND FOUNDERY CO., Ramapo, N. Y.—Spoke and plate-wheels for rail and tramway cars, pig-iron, iron-ores, and test-pieces.

(521.) CHARLES CHURCHILL, New York.—Emery wheels and machines on which they are used.

(522.) KITE & VAN TYNE, Cincinnati, Ohio.—Compound joint for railway-tracks.

(523.) CLEVELAND STEAM GAUGE COMPANY, Cleveland, Ohio.—Steam-gauges.

(524.) J. KNAPP & Co., New York.—Gas-fitters' test-gauge, with diaphragm and proving-pump.

(525.) E. H. ASHCROFT, Boston, Mass.—Steam-gauges.

(526.) LEWIS MILLER, Akron, Ohio.—Automatic self-registering dynamometer.

(527.) CHARLES BEHLEN, Cincinnati, Ohio.—Top-buggy.

(528.) EAMES BIGELOW & Co., South Framingham, Mass.—Carriage-wheels.

(529.) CHARLES WEEKS & Co., New York.—Carriage-wheels.

(530.) W. W. CARRÉ, New Orleans, La.—Dumping-wagon, for lumber, railway-iron, and other material.

(531.) CHARLES T. CARROLL, Baltimore, Md.—Spring motor-power.

(532.) ED. S. GRANT, Middleport, Ohio.—Totten & Co.'s nail-machine, showing Grant's nail-feeder.

(533.) CHARLES T. MUDGE, New York.—Burche's helical hand drill.

(534.) UNIVERSAL FEED SEWING-MACHINE COMPANY, New York.—Sewing-machines. (Court-yard.)

(535.) CHAS. UNDERHILL, Tolland, Conn.—Angular belt for use in the American Department of the Exhibition.

GROUP XIV.—PHILOSOPHICAL, SURGICAL INSTRUMENTS.

Mathematical, Astronomical, Physical, and Chemical Instruments, (Instruments for Measuring, Weighing, and Dividing, for Optical and Electric Telegraphy.) Surgical Instruments and Apparatus (Artificial Limbs, Teeth, &c.) Horological Instruments, Clocks, Watches, and their Parts (Chronoscopes, Chronographs, Electric Clocks.) Statistics of Production.

(536.) F. HOLZACH, New Orleans, La.—Artificial horizon.

(537.) TELEGRAPH SUPPLY MANUFACTURING COMPANY, Cleveland, Ohio.—A closed circuit repeater, (translator,) automatic fire-alarm telegraph apparatus, an electric hotel-annunciator, relays, sounders, keys, &c.

(538.) ARTISTIDE GERARD, New Orleans, La.—Hydroscope, showing the quantity of water in the hull of a vessel.

(539.) FAIRBANKS & CO., New York.—Variety of patent railway, warehouse, portable, counter, and post-office scales, of ten different national standards.

(540.) PETER MAITHRE, Henry County, Indiana.—Coat measure and draught.

(541.) ANDREW G. MYERS, New York.—Pneumatic ships' telegraph, for communicating orders on ship-board from the bridge to the engine-room and wheel, with automatic "telltale" attachment, for reporting whether or not the order is obeyed. In use in the United States Navy.

(542.) JOHN SPARE, New Bedford, Mass.—Hyperbolical paraboloid and hyperboloid.

(543.) WILLIAM B. WATKINS, Jersey City, N. J.—Improved double-acting telegraph circuit and instruments for operating the same; improved self-acting signal-telegraph system; fire and burglar alarm, and instruments for operating the same.

(544.) THE BRYANT CELESTIAL INDICATOR COMPANY, Hartford, Conn.—The Bryant celestial indicator.

(545.) DARLING, BROWN & SHARPE, Providence, R. I.—Instruments for measuring.

(546.) MERRIT GALLY, Rochester, N. Y.—Printing telegraph.

(547.) TICE MANUFACTURING COMPANY, New York.—Water-meters.

(548.) G. H. SCHESCH, Brooklyn, N. Y.—Water-gauge for vessels.

(549.) JAMES LESLIE, Cincinnati, Ohio.—Crystalline gold for dentists.

(550.) MOFFITT & HAVERSTICK, Philadelphia, Pa.—Dentists' amalgam.

(551.) H. D. JUSTI, Philadelphia, Pa.—Artificial teeth, chair and head-rest, dental instruments.

(552.) CHARLES ABBY & SONS, Philadelphia, Pa.—Dentists' gold-foil.

(553.) SAMUEL S. WHITE, Philadelphia, Pa.—Porcelain teeth, burring engines, dental instruments, gold-foils, dental operating-chairs.

(554.) J. A. DEHART, New Orleans, La.—Teeth on gold plates and vulcanized rubber.

(555.) HENRY SPILLMAN, New Orleans, La.—Abdominal supporters, with or without uterine supporters, lever and supporter truss, shoulder-braces.

(556.) BENJAMIN F. SMITH, New Orleans, La.—Jaw or masticating teeth.

(557.) P. NITZELNADEL, Brooklyn, N. Y.—Microscopic preparations,

exhibiting the principal tumors observed in the human body; the normal human tissues and organs, their development and pathological changes.

(558.) H. F. CLARK, Ponghkeepsie, N. Y.—Artificial dentures.

(559.) W. JONES & Co., Syracuse, N. Y.—Trusses and supporters.

(560.) BENJAMIN LEE, Philadelphia, Pa.—Apparatus for the treatment of spinal curvatures.

(561.) J. ALLEN & SON, New York.—Artificial dentures.

(562.) AUTENRIETH & HIMMER, New York.—Electric regulator and clock.

(563.) SETH THOMAS CLOCK COMPANY, New York.—Clocks and movements.

(564.) C. F. TAYLOR, New York.—Surgical instruments.

(565.) HENRY TWITCHELL, Cincinnati, Ohio.—Acidometer.

(566.) Capt. ALBERT JAYNOR, Atlanta, Ga.—Pneumatic telegraph instrument.

GROUP XV.—MUSICAL INSTRUMENTS.

Musical Instruments. Parts of them (Strings, Bows, Molding Boards, Membranes, Keys, Pipes, &c.) Sound-Carrying Apparatus (Speaking-Pipes, Signal Whistles, &c.) Bells, Chime of Bells. Statistics of Production. (*Vide* Additional Exhibition, No. 3.)

(567.) GEORGE STECK, New York.—Piano-fortes.

(568.) J. ESTEY & Co., Brattleborough, Vt.—Cottage-organs.

(569.) FRANZ SCHWARZER, Washington, Mo.—Zithers.

(570.) MASON & HAMLIN ORGAN COMPANY, Boston, Mass.—Cabinet-organs.

(571.) GEORGE GEMUNDER, Astoria, L. I.—Violin.

(572.) HINZEN ROSEN & Co., Lonisville, Ky.—Piano-forte.

(573.) ALFRED DOLGE, New York.—A variety of sheet-felt for piano-makers' use.

GROUP XVI.—THE ART OF WAR.

Organization and Recruiting of Armies. Equipment of Troops, Accouterments, and Armor. Artillery. Military Engineering. Sanitary Contrivances. Military Education, Training, and Instruction. Cartography and Historiography.

(574.) COLT'S PATENT FIRE-ARMS MANUFACTURING COMPANY, Hartford, Conn.—Fire-arms.

(575.) SMITH & WESSON, Springfield, Mass.—Revolvers.

(576.) SHARPS RIFLE MANUFACTURING COMPANY, Hartford, Conn.—Military and other arms.

(577.) UNITED STATES ARMORY, Springfield, Mass.—United States Army rifles, carbines and pistols, in their different stages of manufacture; ammunition for the same.

(578.) SCHUYLER, HARTLEY & GRAHAM, New York.—Ammunition and equipments; Army saddles.

(579.) SCHOVERLING & DALY, New York.—Fire-arms.

(580.) BETHEL BURTON, Brooklyn, N. Y.—Breech loading fire-arms, and magazine, guns, swords, and pistols.

(581.) PROVIDENCE TOOL COMPANY, Providence, R. I.—Breech-loading fire-arms, infantry muskets, cavalry carbines, and sporting-rifles.

(582.) E. REMINGTON & SONS, Ilion, N. Y.—Arms and ammunition.

(583.) JOHN ALLEN TERRELL, Bloomfield, Ky.—Operating model of a perforated re-enforce breech-loading cannon.

(584.) WILLIAM F. FARWELL, New York.—Machine-guns.

(585.) WAR DEPARTMENT, UNITED STATES ARMY, by Quartermaster-General, Schuylkill Arsenal, Philadelphia, Pa.—Army uniforms.

(586.) JAMES PATTON TAYLOR, Elizabethton, Tenn.—Field-piece. (Court-yard.)

(587.) J. S. ALEXANDER, Philadelphia, Pa.—Bayonet-spade.

(588.) THOMAS W. EVANS, Paris, France.—Model railway-car, tent and furniture designed for hospitals and field use. (In America.)

GROUP XVII.—THE NAVY.

Materials for Naval Architecture. Models and Drawings of Boats and Ships for Inland Lake and River Navigation; Sea-going Ships, Coasting Vessels, Merchant Ships, and Ships of War, Stores and Fittings for Equipment, Outfit, and Armament of Ships. Tools and Apparatus used in Ship-building. Land and Water Works for Navigation, (Models and Drawings of Docks, Harbors, Sluices, Floating Docks, Floating Batteries, and Coast Defenses.) Clothing, Outfit and Accommodations for Crews. Hydrography, Charts, Meteorological Instruments; Education of Seamen and Officers.

(589.) E. G. THURBER, commander United States Navy.—Plug and ferrule for boiler-tubes, and apparatus for shipping boat-rudders.

(590.) JOSEPH FUNK, Tompkinsville, N. Y.—Funk's float-lamp.

(591.) JOHN B. STONER, New York.—Improved float, floating-telegraph, light-house and life-boat station, apparatus for saving life at sea, and life-saving suits.

(592.) WILLIAM F. COSTON, New York.—Chart of Coston's telegraphic night-signals, showing arrangement of colors and mode of igniting them.

(593.) P. D. RODDY, New York.—Thiers's automatic ship-ventilator, fog-alarm, and bilge-pump, worked by motion of the vessel.

(594.) LIGHT-HOUSE BOARD OF UNITED STATES, Washington, D. C.—Oil-paintings and photographs of light-houses, light-house publications, specifications, and pamphlets.

(595.) WILLIAM YOUNG, superintendent galley department, navy-yard, Washington, D. C.—Model of ship's galley.

Group XVIII.—Civil Engineering, Public Works, and Architecture.

Building Materials: Processes and Apparatus for Quarrying, Brick making; Iron Girder Work; Preparation and Preservation of Wood; Artificial Stone, Terra-cotta Work, &c.; Materials and Appliances for Foundations, (Pile-drivers, Screw-piles, Coffer Dams, Caissons, Pneumatic and Diving Apparatus.) Contrivances and Tools for Earth-works, (Excavators, Dredging Machines, Apparatus for Raising, Carrying, and Transporting Earth and Materials.) Materials and Apparatus used for Roads and Railways, (Road Rollers; Railway Superstructure, Switches, Crossings, Turn-tables, Traversing-tables, Inclined Planes, Lifts; Pneumatic and other Modes of Propelling; Water Stations and their Apparatus, Railway Station Buildings of all kinds, and Systems of Railway Signals.) Hydraulic Engineering Works, excluding Sea Works, (River Works, Canal Works, Dikes, Locks, Dams, &c.) Models and Plans of Viaducts, Bridges, and Aqueducts, &c. Plans, Models, and Drawings of Public Buildings, Dwelling-houses, Barracks, Penitentiaries, Prisons, and Hospitals, Schools, and Theaters, Laborer's Cottages; Apparatus for Lifting and Moving Heavy Weights in Buildings, as Lifts, &c.; Plans and Models of Cheap Dwelling-houses; Tools and Implements of Artisan Builders. Apparatus and Inventions for Health, Comfort, and Convenience in Buildings, (for Lighting, Water Supply, Drainage, Water-closets, Lightning Conductors, &c.) Agricultural Engineering; Plans for Culture, Fencing, Draining; Farm Buildings; Buildings for Cattle Breeding; Stores, Stables, Manure-tanks, &c. Industrial Buildings; Spinning-mills, Weaving-mills, Grinding-mills, Distilleries, Breweries, Sugar Manufactories; Warehouses, Saw-mills, and Docks, &c.

(596.) J. Enthoffer, United States Coast Survey, Washington, D. C.—Tableau representing the science and art of topographical drawing, plan showing the contemplated improvements of the public reservations between the President's Mansion and the Capitol.

(597.) Theodore Voelckers, Boston, Mass.—Models and patterns of plates and anchors for support of floor-timbers.

(598.) Union Wood-Preserving Company, New Orleans, La.—Wood prepared for preservation.

(599.) McGowan Pump Company, Cincinnati, Ohio.—Model of a watering column for railroad station.

(600.) Albert Fink, Louisville, Ky.—Model of Fink's patent deck-suspension truss-bridge: photographs of the Ohio River bridge at Louisville, Kentucky, and views showing the manner of constructing the same.

(601.) Lewis W. Leeds, New York.—Drawing for ventilation and heating of school-houses.

(602.) George F. Foote, Middletown, N. Y.—Spray bath.

(603.) R. D. Wood & Co., Philadelphia, Pa.—Fire-hydrant.

(604.) James W. R. Hill, New York.—Model of self-sustaining fence.

(605.) E. A. Brackett, Winchester, Mass.—Fish-way.

(606.) G. W. Bacon & Co., London, England.—Portable gymnasium.

(607.) United States War Department, by Brevet Major-General John Newton, New York.—Model of excavations at Hallett's Point, Hell-Gate, East River.

(608.) William W. Batchelder, New York.—Batchelder's electric torches.

(609.) American Institute of Architecture, New York.—Architectural photographs.

(610.) Henry Reck, of Reck & Dannat, architects, New York.—Various buildings erected in connection with the Exhibition.

Group XX.—The Farm-House: Its Arrangements, Furniture, and Utensils.

(611.) F. H. Appleton, West Roxbury, Mass.—Plan of a model New England farm, with views and statistics.

Group XXI.—National Domestic Industry.

Pottery and Porcelain. Fabrics, Tapestry, Embroidery, Lace, and other Needlework. Metal Articles and Ornaments. Carved Work and Utensils.

(612.) Emma Leiser, Brooklyn, N. Y.—Embroidered picture.

(613.) Mary E. Burr, Jackson, Mich.—Phantom bouquet, piece of embroidery.

Group XXIII.—Art applied to Religion.

Decoration of Churches, (Wall Decoration, Stained Glass, Glass Painting, &c.) Church Furniture, (Altars, Organs, Pulpits, Pews, Shrines for enclosing Sacred Vessels, &c.) Ornaments for Altars, Pulpits, Crucifixes, Chalices, Liburiums, Candlesticks, Altar Hangings and Carpets, Pulpit Hangings, &c. Objects used in Baptism and Funerals, &c.

(614.) Samuel Stein, New York.—Improved burial-casket.

(615.) J. & R. Lamb, New York.—Bronze lectern.

Gallery of Fine Arts.

Group XXV.—Fine Arts of the Present Time, Works produced since the Second London Exhibition of 1862.

Paintings, including Miniatures and Enamels. Sculpture, including Figures and Groups of Small Sizes; Engraving, Medals, &c. Architecture, including Models, Designs, Sketches, and Surveys of Archi-

tectural Works of the present time. Graphic arts, including Copper and Steel Engravings, Etching, Woodcuts, &c.

(616.) AMES VAN WART, New York.—Statute in plaster, "Sleeping Beauty," from Tennyson's poem, The Day Dream.

(617.) J. ENTHOFFER, United States Coast Survey, Washington, D. C.—Proof of chromo-chalcography.

(618.) BYRON M. BRICKETT, New York.—Colossal portrait-bust of Prof. S. F. B. Morse.

(619.) ALBERT BIERSTADT, New York.—Oil-painting, "The Emerald Pool," White Mountains, New Hampshire.

(620.) Madame MARY STEVENSON-CASSETT, Philadelphia, Pa.—Oil-painting.

(621.) C. GRANVILLE WAY, Boston, Mass.—Landscape-painting.

(622.) MARCUS WATERMAN, Providence, R. I.—Oil-painting, "Gulliver in Lilliput."

(623.) WILLIAM W. WHITTERIDGE, New York.—Oil-painting, "Landscape in Westphalia."

(624.) E. T. ANDREWS, Steubenville, Ohio.—Oil-painting.

(625.) JOHN R. TAIT, Cincinnati, Ohio.—Oil-painting, "Solitude."

(626.) HENRY MOSSLER, Cincinnati, Ohio.—Oil-paintings.

(627.) THOMAS S. NOBLE, Cincinnati, Ohio.—Oil-painting, "John Brown."

(628.) WILLIAM E. MARSHALL, New York.—Engraved portrait of Abraham Lincoln.

(629.) H. A. ELKINS, Chicago, Ill.—Oil-painting, "Mount Shasta, N. California, U. S. A."

(630.) A. BIERSTADT, New York.—Oil-painting.

(631.) J. A. BAILLY, Philadelphia, Pa.—Bronze portrait in alto-relievo of the Indian chief "Ogontz."

GROUP XXVI.—EDUCATION, TEACHING, AND INSTRUCTION.

Education: Exhibition of all the Arrangements and Contrivances for the better Nursing, Training, and Rearing of Children; their Physical and Mental Development from the first day of their life up to School-time; their Nourishment. Cradles, Nurseries, &c.; Child Gardens, (kindergarten,) Child Games and Amusements, Child Gymnastics. Teaching: Exhibition of School-houses and School Apparatus in Models, Drawings, and Examples. Exhibition of Means of Instruction. The Works and Journals of Instruction. Description and Illustration of Methods of Instruction. History and Statistics of a School, its Organization and Laws. Elementary Schools: This department will include Apparatus for the Instruction of the Blind, Deaf, Dumb, and Idiots. Middle Schools: Comprehending Gymnasiums, "Realschulen," or Schools wherein exact Science and Modern Languages are taught. Professional and Technical Colleges. Universities. Instruction in the more Limited Sense:

Instruction of Adults through Literature, the Public Press, Public Libraries, and Educational Societies, and Associations for Instruction.

(632.) JEFFIR, BUCHER & JEFFIR, New York.—Panoramic school pparatus.

(633.) HERRMAN REFFELTS, Hoboken, N. J.—Fractional frame calulating-machine, and double Russian frame.

(634.) AMERICAN PRINTING-HOUSE FOR THE BLIND, Louisville, Ky.—Books for the blind.

(635.) J. NEWTON PIERCE & R. PATON, New York.—School apparatus.

(636.) JOHN GUNDRY, Cincinnati, Ohio.—Specimens of penmanship.

(637.) W. G. SHATTUCK, Boston, Mass.—School-desks.

(638.) F. W. NICHOLS, Boston, Mass.—School apparatus.

(639.) J. NEWTON PIERCE & ROBERT PATON, New York.—Folding-desk, reversible school-seat, and assortment of slates.

(640.) R. B. MONTGOMERY, New Orleans, La.—Pen-drawing and caligraphy.

(641.) H. J. JOHNSON, New York.—Johnson's Illustrated Family Atlas.

(642.) AMERICAN GEOGRAPHICAL SOCIETY, New York.—Photographs of natural scenery, maps, charts, and statistical publications.

(643.) ERNEST STEIGER, New York.—Collection of periodicals published in the United States.

(644.) T. ELLWOOD ZELL, Philadelphia, Pa.—Encyclopedia.

(645.) J. Q. A. WARREN, New York.—Specimens of the natural history of America, in botany, conchology, entomology, ornithology, and oology. 619.

(646.) Miss SARAH E. FULLER, New York.—Specimens of wood-engraving. (Work of women.)

(647.) NEW YORK AMATEUR PRESS ASSOCIATION, New York.—Representative amateur journalism.

ADDITIONAL EXHIBITIONS.

(648.) H. H. KRESKIN, Cincinnati, Ohio—Natural preserved flowers.

(649.) Mrs. DWIGHT MERRIMAN, Jackson, Mich.—Album of autumn leaves.

(650.) L. C. DODGE, Burlington, Vt.—Photographs showing first settlement, rise, and growth of Burlington, Vt.

(651.) DUN, BARLOW & Co., New York City.—The Mercantile Agency books.

TEMPORARY EXHIBITIONS.

(652.) EDWIN D. MASON, Richmond, Vt.—Cheeses.

(653.) E. G. & E. M. CRANE, Caldwell, N. J.—Cranberries.

(654.) EDWARD NORTON, Goshen, N. Y.—Pine-apple cheeses, bag in which cheese is pressed, net to make impressions.

64. *Contributions of the several States of the Union.*

Group.	Alabama.	California.	Colorado.	Connecticut.	Dist. Columbia.	Georgia.	Illinois.	Indiana.	Kansas.	Kentucky.	Louisiana.	Maine.	Massachusetts.	Maryland.	Michigan.	Missouri.
I. Mining, Quarrying, and Metallurgy	.....	1	2	.....	.....	.....	2	1	.....	.....	3	.....	.....	.....	1	7
II. Agriculture, Horticulture, and Forestry	2	1	.....	.....	.....	.....	.....	1	.....	.....	19	.....	.....	.....	.....	6
III. Chemical Industry	.....	.....	.....	.....	.....	.....	2	.....	.....	1	3	.....	4	.....	.....	1
IV. Substances of Food as Products of Industry	.....	3	.....	.....	.....	.....	1	1	.....	1	19	1	12	.....	.....	9
V. Textile Industry and Clothing	.....	.....	.....	.....	1	.....	1	.....	.....	.....	3	.....	2	1	.....	2
VI. Leather and India-rubber Industry	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	1	.....	2	1	.....	1
VII. Metal Industry	.....	.....	.....	4	1	.....	2	.....	1	.....	1	.....	10	.....	.....	.....
VIII. Wood Industry	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1	.....	2	.....	.....	.....
IX. Stone, Earthenware, and Glass Industry	.....	1	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	2
X. Small Ware and Fancy Goods	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	1
XI. Paper Industry and Stationery	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
XII. Graphic Arts and Industrial Drawing	.....	3	.....	.....	1	.....	2	.....	.....	.....	4	.....	1	.....	.....	2
XIII. General and Agricultural Machinery	.....	.....	.....	14	.....	.....	8	1	1	.....	2	.....	17	2	.....	.....
XIV. Philosophical and Surgical Instruments	.....	.....	.....	1	.....	1	.....	1	.....	.....	5	.....	2	.....	.....	.....
XV. Musical Instruments	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	1
XVI. The Art of War	.....	.....	.....	2	.....	.....	.....	.....	.....	1	.....	.....	3	.....	.....	.....
XVII. The Navy	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
XVIII. Civil Engineering, Public Works, and Architecture	.....	.....	.....	.....	1	.....	.....	.....	.....	1	1	.....	2	.....	.....	.....
XX. The Farm-house	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....
XXI. National Domestic Industry	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
XXIII. Art applied to Religion	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
XXV. Fine Arts of the Present Time	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....
Total	2	9	2	23	6	1	20	5	2	8	65	1	55	4	2	33

Group.	Mississippi.	Nevada.	New York.	New Jersey.	North Carolina.	Ohio.	Pennsylvania.	Rhode Island.	Tennessee.	Texas.	Virginia.	West Virginia.	Vermont.	Wisconsin.	Miscellaneous.	Total.
I. Mining, Quarrying, and Metallurgy	.....	1	7	1	.....	5	4	.....	.....	.....	.....	.....	.....	.....	.....	36
II. Agriculture, Horticulture, and Forestry	1	.....	4	.....	.....	4	.....	.....	1	1	1	.....	.....	1	.....	42
III. Chemical Industry	.....	.....	17	.....	.....	8	4	.....	.....	.....	.....	.....	.....	.....	1	41
IV. Substances of Food as Products of Industry	.....	.....	18	.....	.....	11	1	.....	.....	.....	1	.....	1	.....	.....	69
V. Textile Industry and Clothing	.....	.....	11	.....	.....	3	3	1	1	.....	.....	.....	.....	.....	.....	34
VI. Leather and India-rubber Industry	1	.....	14	1	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	25
VII. Metal Industry	1	.....	21	3	.....	5	2	1	.....	.....	.....	.....	1	.....	.....	53
VIII. Wood Industry	.....	.....	2	.....	.....	6	1	.....	.....	.....	.....	.....	.....	.....	.....	13
IX. Stone, Earthenware, and Glass Industry	.....	.....	4	.....	.....	4	3	.....	.....	.....	.....	.....	3	.....	.....	19
X. Small Ware and Fancy Goods	.....	.....	2	1	.....	.....	1	.....	.....	.....	.....	.....	1	.....	1	10
XI. Paper Industry and Stationery	.....	.....	6	2	.....	4	3	.....	.....	.....	.....	.....	.....	.....	.....	17
XII. Graphic Arts and Industrial Drawing	.....	.....	13	2	.....	5	3	.....	.....	.....	.....	.....	.....	.....	.....	36
XIII. General and Agricultnral Machinery	.....	.....	58	4	1	23	8	6	.....	.....	.....	1	1	.....	4	151
XIV. Philosophical and Surgical Instruments	.....	.....	11	1	.....	3	5	1	.....	.....	.....	.....	.....	.....	.....	31
XV. Musical Instruments	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	6
XVI. The Art of War	.....	.....	5	.....	.....	.....	2	1	1	.....	.....	.....	.....	.....	1	16
XVII. The Navy	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	8
XVIII. Civil Engineering, Public Works, and Architecture	.....	.....	7	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	1	15
XX. The Farm-house	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
XXI. National Domestic Industry	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
XXIII. Art applied to Religion	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
XXV. Fine Arts of the Present Time	.....	.....	6	.....	.....	4	2	1	.....	.....	.....	.....	.....	.....	.....	16
Total	3	1	216	15	1	86	43	12	3	1	2	1	9	2	10	643

65. *The awards at the Vienna Exhibition* were distributed among about 70,000 exhibitors. Of this number, 26,002 were awarded diplomas of honor, medals of progress or of merit, diplomas of approval, (*i. e.*, honorable mention,) medals for good taste, fine arts, or for co-operation. These 26,002 distinctions were distributed as follows:

421 diplomas of honor.
3,024 medals for progress.
10,465 diplomas of approval, (*i. e.*, honorable mention.)
8,800 medals of merit.
326 medals for good taste.
978 fine-arts medals.
1,988 medals awarded to workmen, &c.

Classified as to countries, the awards were distributed as follows:

1. Austria	5,991	17. Roumania	238
2. Germany	5,066	18. Japan	217
3. France	3,142	19. Brazil	202
4. Italy	1,908	20. Greece	183
5. Hungary	1,604	21. China	118
6. Spain	1,157	22. Egypt	75
7. England	1,156	23. South America	44
8. Russia	1,018	24. Persia	29
9. Switzerland	723	25. Morocco	20
10. Belgium	612	26. Madagascar, &c	10
11. Sweden and Norway	534	27. Monaco	9
12. Turkey	470	28. Sandwich Islands	8
13. United States	442	29. Mexico	1
14. Portugal	431	30. Siam	1
15. Denmark	309	31. Turkestan	1
16. Holland	284		

66. *Tabular exhibit of distribution of awards.*

Countries.	Diplomas of honor.	Medals of progress.	Diplomas of approval.	Medals of merit.	Medals for good taste.	Fine-arts medals.	Co-operator medals.	Foreman's medals and diplomas.
1. Austria	66	633	2,520	1,977	121	124	550	*134
2. Germany	100	630	1,951	1,820	41	200	324	13
3. France	83	547	913	940	43	240	376	18
4. Italy	19	163	867	650	18	97	94	9
5. Hungary	15	101	816	516	8	25	123	*
6. Spain	8	117	593	374	7	18	40	.....
7. England	28	169	432	420	13	49	45	10
8. Russia	20	124	281	362	13	47	71	5
9. Switzerland	22	92	258	257	3	33	58	5
10. Belgium	20	86	155	183	6	90	72	5
11. Sweden and Norway	9	57	236	181	.....	15	31	7
12. Turkey	2	30	227	174	18	.....	19	.....
13. United States	9	72	154	177	5	16	9	5
14. Portugal	1	36	218	144	.....	.....	32	5
15. Denmark	2	27	138	100	9	8	25	4
16. Holland	6	39	91	109	3	25	11	4
17. Roumania	1	9	145	68	4	.....	11	.....
18. Japan	4	40	72	92	1	.....	8	.....
19. Brazil	2	25	77	88	1	.....	9	.....
20. Greece	1	7	114	47	1	4	9	3
21. China	2	10	28	47	3	.....	28	.....
22. Egypt	1	6	16	33	5	1	13	.....
23. South America	.....	1	33	9	.....	.....	1	.....
24. Persia	.....	2	8	14	.....	.....	5	.....
25. Morocco	.....	1	7	8	1	.....	3	.....
26. Madagascar, &c	.....	.....	7	3	.....	.....	.....	.....
27. Monaco	.....	.....	2	3	2	.....	2	.....
28. Sandwich Islands	.....	.....	4	3	.....	.....	1	.....
29. Mexico	.....	.....	.....	1	.....	.....	.....	.....
30. Siam	.....	.....	1	.....	.....	.....	.....	.....
31. Turkestan	.....	.....	1	.....	.....	.....	.....	.....

*Austro-Hungary received 134 "honorable mentions."

67. Classified by groups, the distribution was as follows:

Group.		Group.	
I	557	XV	314
II	2,504	XVI	251
III	1,465	XVII	232
IV	3,555	XVIII	599
V	4,511	XIX	74
VI	584	XX	24
VII	1,755	XXI	983
VIII	741	XXII	11
IX	841	XXIII	120
X	1,001	XXIV	...
XI	471	XXV	...
XII	994	XXVI	1,340
XIII	1,280	Additional exhibits	302
XIV	605		

68. The statistics of the diplomas of honor, according to the number of inhabitants of the following-named countries, were:

	Inhabitants.
United States, one diploma of honor in every	4,283,998
Russia, one diploma of honor in every	3,550,000
Italy, one diploma of honor in every	1,405,000
Great Britain, one diploma of honor in every	1,222,000
Denmark, one diploma of honor in every	900,000
Sweden and Norway, one diploma of honor in every	655,000
Holland, one diploma of honor in every	650,000
France, one diploma of honor in every	462,000
Austro-Hungary, one diploma of honor in every	443,000
Germany, one diploma of honor in every	410,000
Belgium, one diploma of honor in every	250,000
Switzerland, one diploma of honor in every	108,000

Résumé of awards granted to different countries in Group XIII, machinery.

Countries.	Number of exhibitors.	Diploma of honor.		Medals of progress.		Medals of merit.		Diploma of recognition.		Total number of awards.	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
America, (U. S.)	150	2	1.33	26	17.33	19	12.66	18	12.00	65	43.33
Austria	489	8	1.86	49	10.02	84	14.20	104	35.98	245	50.10
Belgium	52	2	3.84	9	17.31	11	21.15	15	28.80	37	72.55
Denmark	25	1	4.00	2	8.00	4	16.00	5	20.00	12	48.10
England	225	5	2.22	39	17.33	43	19.14	41	18.22	128	56.88
France	259	6	2.31	41	15.90	37	14.30	42	16.20	126	48.64
German Empire	615	10	1.63	83	13.50	169	27.48	79	12.84	341	55.40
Hungary	114	1	0.87	10	8.77	10	8.77	24	21.05	45	39.47
Italy	136	....	.....	.....	.....	4	2.94	11	8.09	15	11.03
Netherland	8	....	.....	.....	.....	1	12.50	4	50.00	5	62.50
Russia	67	1	1.50	7	10.45	16	23.88	13	19.10	37	55.22
Sweden and Norway	51	1	1.96	2	3.92	3	5.90	1	1.96	7	13.72
Switzerland	54	3	5.56	12	22.22	17	31.48	14	25.73	46	85.19
Total	2,245	10	.....	280	.....	418	.....	371	.....	1,109	.....
Average	.....	....	1.78	.....	12.47	.....	18.62	.....	16.52	.....	49.44

69. *List of awards to American Exhibitors at the Vienna Universal Exposition, August* 18, 1873. *Compiled from the official list by the United States Executive Commissioner.*

The following is a list of the awards to the American exhibitors at the "World's Exposition" in Vienna, made August 18, 1873:

DIPLOMAS OF HONOR.

[The diploma of honor was designed to bear the character of a peculiar distinction for eminent merits in the domain of science, and its applications to the education of the people and the advancement of the intellectual, social, and material welfare of man. Awarded exclusively by the Council of Presidents, upon the proposition of the International Jury.]

GRAND DIPLOMAS OF HONOR.

The National Bureau of Education, Washington, D. C.—For distinguished services in the cause of education, and for important contributions to the Exposition.

The Light-House Board of the United States.—For important constructions and improvements in the method of coast-lighting.

The State of Massachusetts.—For valuable reports and documents, and for the enterprise shown by its organized personal representation at Vienna.

The city of Boston.—For its full and complete illustration of its school system and schools.

The Smithsonian Institution, Washington, D. C.—For its efficient labors in the advancement and diffusion of knowledge.

William Sellers & Co., Philadelphia, Pa.—For important improvements in tool-making machinery.

George H. Corliss, Providence, R. I.—Improvements in steam-engines.

S. S. White, Philadelphia, Pa.—Exhibition of dentistry and dental instruments.

Walter A. Wood, New York.—Mowing-machines.

Diplomas of Honor were awarded also to Members of the International Jury, as follows:

Group 1.—Thomas P. Egleston, New York City; W. P. Blake, New Haven, Conn.

Group 2.—John A. Warder, North Bend, Ohio.

Group 3.—J. Lawrence Smith, Louisville, Ky.

Group 4.—E. N. Horsford, Cambridge, Mass.

Group 5.—Lambert Bigelow, Worcester, Mass.

Group 6.—J. C. Daggett, Boston, Mass.

Group 7.—Howard Painter, Philadelphia, Pa.

Group 8.—N. M. Lowe, Boston, Mass.

Group 9.—Louis J. Hinton, Ithaca, N. Y.

Group 10.—Frank D. Millet, Cambridge, Mass.

Group 11.—Eben Brewer, New York.

Group 12.—George W. Silcox, New York.

Group 13.—R. H. Thurston, Hoboken, N. J.; Jos. E. Holmes, New York.

Group 14.—Robert B. Lines, Massachusetts.

Group 16.—J. V. Meigs, Lowell, Mass.; George H. Woods, Hartford, Conn.

Group 18.—N. C. Derby, New York; John R. Niernsee, Baltimore, Md.

Group 20.—Peter Collier, Burlington, Vt.

Group 26.—J. W. Hoyt, Madison, Wis.; J. D. Philbrick, Boston, Mass.

COMMERCE—MEDALS FOR PROGRESS.

(Awarded, in Groups I to XXIII and in Group XXVI, to exhibitors who have furnished evidence of considerable progress over similar products shown at former Universal Exhibitions, by new inventions, or who, by the introduction of new materials and contrivances, &c., or by their efforts, have otherwise essentially contributed to the progress of industry or to the improvement of society.)

American Geographical Society, New York.—Statistical publications.

Anthony, E. & H. T., & Co., New York.—Photographic apparatus.

Avery, John G., Spencer, Mass.—Wool-spinner.
Bigelow, Horace H., Worcester, Mass.—Shoe-machinery.
Billings & Spencer Manufacturing Company, Hartford, Conn.— Wrought-iron and steel forgings for machinery.
Brown & Sharpe Manufacturing Company, Providence, R. I.—Milling-machines.
Bruce's Son, George, & Co., New York.—Book of types.
Buena Vista Vinicultural Society, San Francisco, Cal.—"Pearl of California," "Buena Vista," (first and third quality.)
Bush & Howard, Buffalo, N. Y.—Sole-leather, (hemlock.)
Covert, H. C., New York.—Woodbury brush-making machine.
Davidson, Henrietta, New Orleans, La.—Sugar, open kettle centrifugal, without bone-black.
Davis, John G., & Sons, Philadelphia, Pa.—Carriage-wheels.
Dixon, Joseph, Crucible Company, Jersey City, N. J.—Pencils from American graphite, execution of all pencil manufactures by machinery.
Douglas, W. & B., Middletown, Conn.—Pumps.
Eberhart & Lachman, San Francisco, Cal.—American wines.
Erkenbrecher, Andrew, Cincinnati, Ohio.—Starches.
Excelsior Gas Machine Company, Warren, Pa.—Apparatus for making gas.
Fairbanks & Co., New York.—Scales and weights.
Guyot, Professor, Princeton, N. J.—Wall-maps.
Hall, Thomas, Northampton, Mass.—Parallel bench-vises.
Houseworth, Thomas, San Francisco, Cal.—Photographs of American scenery.
Howes, Babcock & Co., Silver Creek, N. Y.—"Eureka" smut and separating machines.
Howe, George W., Cleveland, Ohio.—Knitting-machines.
Howe Machine Company, New York.—Sewing-machines.
Howe, Dr. G. S., Boston, Mass.—Publications for the blind.
Johnston Harvester Company, Brockport, N. Y.—Mowers and reapers.
Justi, H. D., Philadelphia, Pa.—Artificial teeth; instruments and apparatus used in dentistry.
Knapp Dovetailing Machine Company, Northampton, Mass.—Dovetailing-machine.
Leigh, Edwin, New York.—Tablets and books in pronouncing types.
Leroy, Fairchilds & Co., New York.—Gold pens, gold pen and pencil cases.
Lilly, Young, Pratt & Brackett, Lynn, Mass.—Boots and shoes.
Lopez, D., New Orleans, La.—Assorted chocolate.
Mason & Hamlin Organ Company, Boston, Mass.—Cabinet-organs.
Matthews, John, New York.—Patent apparatus for making soda-water.
Maurice, Charles, New York.—Autographic printing cylinder.
Miller, Lewis, Akron, Ohio.—Automatic self-registering dynamometer.
Morse Twist Drill Company, New Bedford, Mass.—Patent increase twist drills.

Mowry (The) Axle and Machine Company, Genesee, N. Y.—West's American tire-setter.

Muybridge, San Francisco, Cal.—Photographs of landscapes.

National Educational Association.—Successful efforts in promoting the advancement of education.

Ohio State Department of Public Instruction, (J. W. Harvey, Commissioner,) Columbus, Ohio.—School reports, statistics, &c.

Osborne, D. M., & Co., Auburn, N. Y.—Mowing and reaping machines.

Pickering & Davis, Portland, Conn.—Regulators.

Pleasant Valley Wine Company, Hammondsport, N. Y.—"Great Western," "Carte Blanche," and "Paris Exposition" champagnes, still wines, and brandies.

Pomeroy & Plummer, New York.—Fancy cassimeres and coatings.

Pork Packers' Association, Cincinnati, Ohio.—Cartoons illustrating the pork slaughtering and packing industry as conducted at Cincinnati, Ohio, (executed in crayon.)

Prang, L., & Co., Boston, Mass.—Chromo-lithographs.

Pratt & Whitney Manufacturing Company, Hartford, Conn.—Drill-spindles, screw and milling machinery.

Remington, E., & Sons., New York.—Sewing-machines.

Schwarzer, Franz, Washington, Miss.—Zithers.

Secor Sewing Machine Company, New York.—Sewing-machines.

Singer Manufacturing Company, New York.—Sewing-machines.

Smith & Wesson, Springfield, Mass.—Revolvers.

Sprague Mowing Machine Company, Providence, R. I.—Mowing-machines.

St. Bernard Starch Works, Cincinnati, Ohio.—Improvements in the manufacture of starch.

Stephenson, John, & Co., New York.—Street-car.

Sturtevant, B. Z.—Wood for shoe-pegs.

Taylor, C. F., New York.—Surgical instruments.

Tilghmann, B. C., Philadelphia, Pa.—Sand-blast apparatus for cutting glass and stone.

Warder, Mitchell & Co., Springfield, Ohio.—Mower and reaper, with self-rake attachment.

United States of America.—Collective exhibition of cottons, contributed by Mobile Cotton Exchange; New Orleans Cotton Exchange; F. Ingate, Mobile; N. W. McCall, New Orleans; Williams, Ruperle & Co., New Orleans; J. W. Jefferson & Co., Memphis; A. G. Ingersoll, Mobile; (J. O. Wilson, superintendent.)

Washington, D. C.—Progress in education and in school architecture.

Warth, Albin, Stapleton, L. I.—Machine for cutting clothing by steam-power.

Watkins, C. E., San Francisco, Cal.—Landscape photographs.

Weed Sewing-Machine Company, Hartford, Conn.—Sewing-machines.

Werk, M., and Sons, Cincinnati, Ohio.—Still and sparkling Catawba wines.

Westfield Lock-Works, Westfield, N. Y.—Door-locks, self-registering padlocks, mail-locks, &c.

Wharton, Joseph, Philadelphia, Pa.—Metallic nickel, cobalt nickel, and cobalt salts, castings of nickel and cobalt, &c.

Wheeler & Wilson Sewing-Machine Company, New York.—Sewing-machines.

Whitney, Baxter D., Winchester, Mass.—Machines for wood sawing, turning, planing, boring, &c.

MEDALS FOR MERIT.

(Awarded to exhibitors in consideration of the excellence of the exhibits, the extent of their operations, and the superiority of means and forces employed.)

Abby, Charles, & Sons, Philadelphia, Pa.—Dentists' gold-foil.

Adriance, Platt & Co., New York.—Buckeye mowers, mower and reaper, (self-raking.)

Appleton, D., & Co., New York.—Wall-maps.

Alabama, State of.—Mineral productions.

American Institute of Architecture, New York.—Plans of large State-buildings.

American Printing-House for the Blind, Louisville, Ky.—Books for the blind.

American Social Science Association.—Scientific researches.

American Suspender Company, New York.—Suspender trills, garters, garter and gusset webbing.

Auger, B. A., New Orleans, La.—Extract of Mexican pepper, tomato catsup, raw tomato juice, &c.

Archdeacon, William, Chicago, Ill.—Preserved meats.

Armistead, Lewis L., Lynchburgh, Va.—Manufactures of tobacco.

Astor Library, New York, N. Y.

Aultman, Miller & Co., Akron, Ohio.—"Senior" and "Junior" Buckeye mowers, &c.

Baer, Anthony P., Baltimore, Md.—Sole-leather, (oak.)

Bader, Adolph E., Austrian consul, New Orleans.—Sugar and molasses.

Baker, Walter & Co., Boston, Mass.—Chocolate and cocoa preparations.

Banister & Tichener, New York—Shoes.

Barnard, Dr. Henry, Hartford, Conn.—American Journal of Education.

Barney, E. H., Springfield, Mass.—Gold, silver, and nickel-plated and blued skates, the Barney & Berry patent club and rink skates.

Barstow Stove Co., Providence, R. I.—Cooking-stove and portable range.

Batcheller & Sons, Wallingford, Vt.

Behan, Thorn & Co., New Orleans, La.—Alcohol.

Bergner, Theodore, Philadelphia, Pa.—Improved parallel ruling and section lining instrument, drawing-instruments.

Bienville Oil Works, New Orleans, La.—Cotton-seed oil, cotton seed and cotton-seed hulls.

Bierstadt, Charles, Niagara Falls, N. Y.—Stereoscopic views of Niagara Falls and of California scenery.

Bourgeois, Idmond, Saint James Parish, La.—Perique tobacco.

Bowen, Henry, Philadelphia, Pa.—Crystals of yellow prussiate of potash, pure inodorous glycerine.

Brewer, Gardner & Co., Boston, Mass.—Fine "G. B." shirtings, brown-bleached, manufactured by the Langdon Manufacturing Co., Manchester, N. H.

Buckley, Lockwood & Co., New York.—Sole-leather.

Bullock, A. D., Cincinnati, Ohio.—Hair and bristles.

Burckhardt & Co., Cincinnati, Ohio.—Lard-oil, illuminating petroleum, &c.

Bureau of Engraving and Printing, Treasury Department, Washington, D. C.—Engravings.

Burt, Edwin C., New York.—Machine-sewed ladies' shoes.

Carett, W. T.—Cigars.

Chicago (Illinois) public schools, (J. L. Pickard, superintendent.)—School reports, examination papers, and statistics.

Churchill, Charles M., New York.—Patent vise, with attachments.

Cincinnati (Ohio) public schools, (John Hancock, superintendent.)—Reports, examination papers, and educational statistics.

Colgate & Co., New York.—Toilet soaps.

Collins & Co., New York.—"Eclipse" gang-plow.

Colt's Patent Fire-Arms Manufacturing Company, Hartford, Conn.—Fire-arms.

Cooper, H. P., New York.—Clothing.

Cooper Union, New York.—For labors in the interest of the working classes.

Cowing & Co., Seneca Falls, N. Y.—American driven wells, and materials used in sinking the same.

Cowperthwait & Co., Philadelphia, Pa.—Warren's wall-maps and books.

Darling, Brown & Sharpe, Providence, R. I.—Instruments for measuring.

Deere & Co., Mobile, Ill.—Plows and cultivators.

Dixon, Joseph, Company, Jersey City, N. J.—Crucibles made of American graphite.

Dixon, Joseph, Crucible Company, Jersey City, N. J.—Dixon's pure American graphite, for electrotyping, lubricating, polishing, &c.

Dolge, Alfred, New York.—Sheet-felt for pianos.

Douglas Ax Manufacturing Company, Boston, Mass.

Duval & Hunter, Philadelphia, Pa.—Chromo-lithographs.

Eclipse Lubricating-Oil Company, New York.—Lubricating-oils.

Ellis & Curtis, New York.—Wine.

Fabel, Conrad & Mooney, Louisville, Ky.—Sole-leather, (oak-tanned.)

Fay, J. A., & Co., Cincinnati, Ohio.—Patent band-sawing, scroll-sawing, mortising, boring, and turning machines.

Fox, George, Cincinnati, Ohio.—"Superior," "Diamond-gloss," and "Silken-gloss" starch, and corn-starch.

Fries, Alex., Brothers, Cincinnati, Ohio.—Preserved fruit, essences.

Fuller, Miss Sarah E., New York.—Specimens of wood engraving, (work of women.)

Gest & Atkinson, Cincinnati, Ohio.—Lard, signal, paraffine, mineral, and lubricating oils, vegetable oils, head-light and steamer oils, patent wax candles for railway-coaches.

Gibson's, John, Son & Co., Philadelphia, Pa.—Rye whisky of 1867, 1868, 1869, and 1870, and wheat whisky of 1869-'70.

Goldschmidt, Bachrach & Co., New York.—Gloves cut and sewed by machinery.

Groezinger, G., Ruyter & Co., agents, New York.—Wines and brandies.

Grossius, John, Cincinnati, Ohio.—Patent ventilating school-house stove.

Harper Brothers, New York.—School-books, school-slates, tablets, and charts.

Hauthaway, C. L., & Sons, Boston, Mass.—Leather dressings, &c.

Hill Archimedean Lawn-Mower Company, Hartford, Conn.—Lawn-mowers.

Hotchkiss, H. G., Lyons, N. Y.—American essential oils.

Hotchkiss, L. B., Philps, N. Y.—American essential oils.

Howe, E., Machine Company.—Sewing and embroidering.

Howell, Wm. R., New York.—Photographic portraits.

Indiana, the State of, E. T. Cox, State Geologist, Indianapolis, Ind.—Coals, iron, and stone.

Janensky & Co., Philadelphia, Pa.—Artists' materials.

Johnson, Bradish, New York.—White and yellow sugars.

Johnson, Ephraim.—Gold pens and pen-holders.

Jones & Laughline, Pittsburgh, Pa.—Cold-rolled shafting, for use in American department; also hangers, couplings, and pulleys.

Kimball, San Francisco, Cal.—Light road-wagon.

Kimball, William S., & Co., Rochester, N. Y.—"Peerless" and "Vanity Fair" tobacco.

Kustel, Prof. Guido, San Francisco, Cal.—Ores and minerals from Utah and California.

Lamb Knitting Machine Company, Chicopee Falls, Mass.—Hand knitting-machines.

Landy, James, Cincinnati, Ohio.—Rembrandt photographs.

Le Clerq Brothers, Gallipolis, Ohio.—Doeskin jeans.

Lea, H. C., Philadelphia, Pa.—Medical text-books and American Journal of Science.

Mahler, Moritz, New York.—Fur sacques, patent and fancy muffs, boas, caps, and gloves.

Maillard, H., New York.—Cane sugar.

Martin, James M. C., New York.—Brushes.

McCormick, C. H., Chicago, Ill.—Combined reaping and mowing machine.

McDermott, J., & Co., Cleveland, Ohio.—Grindstones, from Berea, Ohio.

McKesson & Robbins, New York.—American oils, barks, roots, extracts, pills, and sponges.

Michaelis & Kaskel, New York.—Shirts, collars, and underwear.

Milwaukee Chamber of Commerce, Wis.

Moody, S. N., New Orleans, La.—Shirts.

Morningstar, Charles, New York.—Starch.

Morton, James, New York.—Gold pens and holders.

Moser, Chas., & Co., Cincinnati, Ohio.—Oil-paints for artists.

Myers, Andrew G., New York—Pneumatic ship-telegraph, for communicating orders on shipboard from the bridge to engine-room and wheel, with automatic "telltale" (controlling) apparatus.

National School Furniture Company, New York.—School furniture.

Neumann, Joseph, San Francisco, Cal.—Raw and spun silk.

New England Company, Rockville, Conn.

Newton, Brevet Major-General John, New York.—Method of excavations at Hallet's Point, Hell-Gate, East River.

New York City Department of Public Instruction.—School-books, school reports, photographic views of schools, &c., and specimens of school labors.

Northern Pacific Railway Company.—Cereals, fruits, woods, ores, minerals, building-stones, models of fruits and vegetables, maps, views, and statistics.

Norwalk Iron Works, Norwalk, Conn.—Steam-engine of twenty-five horse-power, and steam-pumps, for use in the American department of the Exhibition.

Paine Brothers, New York.—Peppermint, spearmint, wintergreen, sassafras, and other American essential oils.

Pape Brothers & Kugemann, Cincinnati, Ohio.—Gilt moldings.

Park Brothers & Co., Pittsburgh, Pa.—Cast steel.

Parks, A. S.

Pease, F. S., Buffalo, N. Y.—Mineral, animal, and vegetable oils, compound oils for lubricating and illuminating purposes.

Penn, D. B., New Orleans, La.—Sugars, vacuum-pan process.

Peters Brothers, New York.—Tailors' shears of P. Heinrich's Sons' patent, Newark, N. J., domestic knives and scissors.

Poeschel & Sherer, Harreman, Mo.—Catawba, Goethe, Hebemont, Delaware, Taylor, Rulander, and Norton's Virginia wines; Cynthia.

Portland Packing Company, Portland, Me.—Meats, fish, and vegetables, hermetically preserved.

Proctor & Gamble, Cincinnati, Ohio.—Soap and candles.

Providence Tool Company, Providence, R. I.—Arms.

Ramapo Wheel & Foundery Company, Ramapo, N. Y.—Wheels for rail and tramway cars.

Remington, E., & Sons, Ilion, N. Y.—Arms and ammunition.
Remington, S., Ilion, N. Y.—Agricultural implements.
Resor, W., & Co., Cincinnati, Ohio.—"Monitor" cooking-stove, "Red Cross" parlor stove, for bituminous coal.
Richard, London & Kelley, Philadelphia, Pa.—Hand-saws.
Richmann, Henry, Cincinnati, Ohio.—Microscopic photographs.
Roddy, P. D., New York.—Application of equilibrium of fluids in communicating vessels.
Rocher, Henry, Chicago, Ill.—Photographs.
Rogers, C. B., & Co., Norwich, Conn.—Machine for working wood.
Ross, Joseph L., Boston, Mass.—School furniture.
Rothwell, Richard P., New York.—Iron-ores and coal, from Alabama.
Royer Wheel Company, Cincinnati, Ohio.—Railway wheels.
Royer Wheel Company, Cincinnati, Ohio.—Wheels, spokes, and hubs.
Sachse, F., & Sons, Philadelphia.—Shirts.
San Antonio Meat Extract Company, San Antonio, Tex.—Preserved meats.
Sanford & Co., Cleveland, Ohio.—Commercial account-books.
Sargent, Greenleaf & Cole, New York.—Patent adjustable stove-pipe elbows.
Schedler, Joseph, Jersey City Heights, N. J.—Terrestrial and celestial globes.
Scheffer, Emil, Louisville, Ky.—Pepsin.
Scovill Manufacturing Company, New York.—Photographic apparatus.
Sharps Rifle Manufacturing Company, Hartford, Conn.—Military and other arms.
Singer Manufacturing Company, New York.—Sewing-machines and sample of work
Sloane, W. J.—Wilton and Axminster carpets.
Smith, James Y., Manufacturing Company, Providence, R. I.—Brown and bleached shirtings.
Socola, Angelo, New Orleans, La.—Sugars.
Stanley Rule and Level Company, New Britain, Conn.—Planes and bevels.
Steiger, Ernest, New York.—5,000 specimens of different American newspapers and periodicals, school publications.
Stein, Hirsch & Co., Chicago, Ill.—Blood albumen, corn-starch, &c.
Stiles & Parker Press Company, Middletown, Conn.—Punching press.
Sutro Tunnel Company, Sutro, Nev.—Topographical model of Comstock lode, charts, &c.
Tennessee, State of.—Massive samples of iron and coal.
Thilenius, G. C., Cape Girardeau, Mo.—Flour.
Thurber, H. K., New York.—"Old Bourbon" whisky.
Toner, Dr., Washington, D. C.—Collection of the reports of medical institutions, hospitals, &c.
Townsend, H. E., Boston, Mass.—Boot machines.

Underhill, Charles, Tolland, Conn.—Angular driving-belt.
Underwood, William, & Co., Boston, Mass.—Canned fruits, fish, vegetables, and meats.
United States Cartridge Company, Lowell, Mass.—Metallic cartridge for central-fire guns.
United States Armory, Springfield, Mass.—Gunstocks.
Waitt, William B.—Educational apparatus.
Walker, J. H. & G. M., Worcester, Mass.—Boots.
War Department, United States Army, (by Quartermaster-General, Schuylkill Arsenal, Philadelphia, Pa.)—Army uniforms and horse equipments.
Warner, Wm. R., & Co., Philadelphia, Pa.—Sugar-coated pills and granules.
Weed Sewing Machine Company, Hartford, Conn.—Sewing and embroidery.
Weeks, Charles, & Co., New York.—Carriage-wheels.
West, J. B., Genesee, N. Y.—Horse-rake.
Wheeler, Meelick & Co., Albany, N. Y.—Wheel horse-rake.
Wheeler & Wilson, New York.—Wood-work in the manufacture of their machines.
White, C. T., & Co., New York.—Medical chemicals.
Whiting, Luther, Boston, Mass.—New system of musical notes.
Wilcox & Gibbs Sewing Machine Manufacturing Company, New York.—Sewing-machines.
Wilson, Hinkle & Co., Cincinnati, Ohio.—School-atlases and other school publications.
Wilson Sewing Machine Company, Cleveland, Ohio.—Sewing-machines
Wilson Sewing Machine Company, Cleveland, Ohio.—Sewing and embroidery.
Wisconsin Leather Company, Milwaukee, Wis.—Harness-leather wax splits, wax uppers, (hemlock.)
Witherby, Rugg & Richardson, Worcester, Mass.—Planing, grooving, and other wood-working machines.
Witherby, Sherman & Co., Fort Henry, N. Y.—Iron and iron-ores.
Zallie, John, Saint Louis, Mo.—Clothing.

MEDALS FOR FINE ARTS.

(Awarded only to works of eminent merit.)

Bierstadt, Albert, New York.—Painting.
Healey, (in Rome.)—Painting.

MEDALS FOR GOOD TASTE.

(Awarded upon articles of industry, the form and color of which constitute the characteristic features for adjudicature.)

Allen, J., & Son, New York.—Artificial dentures.
Clark, H. F., Poughkeepsie, N. Y.—Artificial dentures.

Harpel, Oscar H., Cincinnati, Ohio.—Specimens of typography.

Kurtz, W., New York.—Plain and colored photographs on paper and porcelain.

National Bank-Note Company, New York.—Frame of bank-note engraving and printing.

MEDALS FOR CO-OPERATORS.

(Awarded for co-operative services, whether in the production of articles exhibited, or in essentially promoting the success of the Exhibition.)

Andersen, Elbert & Kurtz, New York.—Photographs.

Brock, Miss Annie E.—Seamstress and embroideress, with Wilson Sewing-Machine Company, Cleveland, Ohio.

Cox, E. D., State geologist.—For labors in connection with the geological exhibition from Indiana.

Degener, Margarethe, embroideress, with Singer's Sewing-Machine Company, New York.

Fairfield, Geo. A., in charge of the Weed Sewing-Machine Company, Hartford.

Farny, H. F., of Cincinnati.—For drawings.

Felt, Luther W., with John G. Avery, Spencer, Mass.

Hammet, J., at the Weed Sewing-Machine Company, Hartford, Conn.

Klauke, Hermann, embroiderer on leather at the Singer Sewing-Machine Company, New York.

Langhahn, Frau Anna, (Hamburg,) at the Singer Sewing-Machine Company, New York.

Lussey, A. D., at the Wilson Sewing-Machine Company, Cleveland, Ohio.

Mix, E. M., superintendent of the Westfield Lock-Works, New York.

Mix, J. R., superintendent Westfield Lock-Works, New York.

Montraville, Williams, at the Wilson Sewing-Machine Company, Cleveland, Ohio.

Meyer, Miss Therese, with Howe Machine Company, Cleveland, Ohio.

Newburg, F. S., Ohio.—For geological maps, (through Samuel A. Miller.)

Oakley, Selleck, with Wheeler & Wilson Sewing-Machine Company, New York.

Pascall, Richard M., with Pickering & Davis, Portland, Conn.

Perry, Mrs. Myron, with Brothers Kirsch, representative of Wheeler & Wilson, New York.

Reynold, Henry, director at Sargent, Greenleaf & Coles, New York.

Smith, Miss Bertha, with the Howe Machine Company, Cleveland, Ohio.

Stout, Francis A., secretary of the New York Geographical Society.—For statistical works of the library on the political and commercial relations of the United States.

Thomas, R., with the Howe Machine Company, Cleveland, Ohio.

Woods, J. C., with Wheeler & Wilson Sewing-Machine Company, New York.

DIPLOMAS OF MERIT OR HONORABLE MENTION.

Altemus & Co., Philadelphia, Pa.—Photograph albums.
American Boneless Sardine Company, New York.—Sardines.
American Stair Rod Company, New York.—Stair-rods.
American Tack Company, Boston, Mass.—Samples of tacks, brads, &c.
Baker, Charles Henry, Philadelphia.—Self-gauging tuyeres.
Baltimore (Maryland) public schools.—Reports of the board and of superintendent, examination papers in departments of writing and drawing.
Barnes, A. S., & Co., New York.—School publications.
Barr, John J., & Co., New Orleans, La.—Sugar and sirup.
Batchelder, W. W., New York.—Electric torches.
Beckwith, Geo. W., Burlington, Vt.—Green Mountain soluble phosphates.
Bloodgood, A. De Etta, New York.—Studies of wax flowers and leaves.
Blow, Henry T., Saint Louis, Mo.—Zinc-ore from Granby and Minnesota, lead-ore from Granby.
Bogen, Geo., & Co., Cincinnati, Ohio.—Still and sparkling Catawba and red wines.
Bolen & Byrne, New York.—Artificial mineral-waters.
Boomer, Geo. B., Syracuse, N. Y.—Patent lard and wine press.
Bridges, Lyman.—For building the American school-house.
Brown, J. A., New York.—Gold pens and holders.
Burr, Miss M. E., Jackson, Mich.—Phantom bouquet.
Cassard, G., Baltimore.—Purified lard.
Canton, city of, Ohio.—School reports and examination papers in educational department.
Carr, Adam, New York.—Plunger-pump for mines and coal-works.
Chadborn & Coldwell Manufacturing Company, Newburgh, N. Y.—Hand lawn-mower.
Chalvin, H. A., New York.—Cordials.
Churchill, Charles, New York.—Drilling-machines.
Cleveland (Ohio) public schools.—School reports and statistical chart of education in Cleveland.
Cohn, Ieiblick & Co., New York.—Paper hangings in imitation of wood.
Columbus (Ohio) public schools.—School reports and papers.
Coston, Martha T., New York.—Telegraphic night-signals.
Crane, E. G. & E. M., Newark, N. J.—Preserved berries.
Crescent City Steam Sugar Refinery, A. Thompson & Co., New Orleans, La.—Refined sugars and sirups.
Dayton, city of, Ohio.—School reports and examination papers.
Denis, Arthur, New Orleans, La.—Cane sugar; open-kettle process.
Devoe (the) Manufacturing Company, New York, (J. G. Rollins & Co., London, agents.)—Cans with tops of various patterns; samples of oil.
Deyner & Weiler.—Printing-presses
Dougherty, D. A., Kittanning, Pa.—Writing-fluid.

Douglas, J. N., Belleville, Ill.—Nails of assorted sizes.
Dunbar, Hobart & Whidden, South Abington, Mass.—Card of tacks and nails.
Ely, H. G., & Sanger, New York.—Imitation goat-leather.
Enthoffer, J., Coast Survey, Washington.—Topographical drawing.
Fairbanks, H. M. Peck & Co., Chicago, Ill.—Refined lard.
Ferguson & Roseburg.—Sheep-shearing machine.
Ferguson, J. M., New Orleans.
Field, A., & Sons, Taunton, Mass.—Card of tacks and nails.
Fink, Henry, & Co., Lonisville, Ky.—Whisky.
Frantz, D., & Son, Lonisville, Ky.—Sole-leather, (oak.)
Fremont (Ohio) public schools.—School reports, examination papers.
Fromherz, Joseph, Cincinnati, Ohio.—Writing-ink.
Funk, Joseph, Tompkinsville, N. Y.—Float-lamp.
Geemann, Joseph.—Malt-kiln, grain-drier, and malt-sprouter.
Gould.—Pumps.
Gray Brothers, Syracuse, N. Y.—Ladies', misses', and children's shoes, machine-sewed.
Gregan, Nicolas, Saint Louis.—Bacon.
Gunther, G., New York.—Bright metal and silver-plated cages.
Hale & Parshall, Lyons, N. Y.—American essential oils.
Hall, Henry L., Chicago, Ill.—Model of combined seed-sower and cultivator.
Hansom, William R., & Son, Philadelphia.—Variegated Champlain marble, from Mallett's Bay.
Hardy, Milton J., & Co., New York.—Samples of whisky.
Hartel, Andreas & Co., Philadelphia.—Cotton.
Healy, Platt & Co., New York.—Sole-leather, (hemlock.)
Henshaw, Edward, Boston, Mass.—Shoe-tools and samples of shoe-pegs in boxes.
Hinzen, Rosen & Co., Louisville, Ky.—Pianos.
Holland, John, Cincinnati.—Gold pens and holders.
Homer, Lee & Co., New York.—Specimens of cards, monograms, &c.
Horner, James B., New York.—Variety of essential oils.
Horton, E., & Son, Windsor Locks, Conn.—Lathe-chuck for boring or turning.
Horton, G. B., & Co., New York.—Sole-leather, (hemlock.)
Howe, Geo. W., Cleveland, Ohio.—Patent vent and bung.
Hoyt, J. B., & Co., New York.—Sole-leather, (oak bark.)
Hubbard & Curtis Manufacturing Company, Middletown, Conn.—Patent drill-chucks.
Ives Patent Lamp Co., New York.—Hall, bracket, and hanging lamps, chandeliers, lanterns, and lamp fixtures, globes, chimneys, &c.
Johnston, C. S., New York.—Magnetic iron-ore, from the mines at Clifton, N. Y.
Keck & Mossen, New York.—Sole-leather, (union crop.)
Kellogg, M. K., New York.—Patent frame-stretchers.

Kennedy, Patrick J., New Orleans.—Sugar clarified by sulphur and lime.
Krammelberg's Manufactory, Baltimore.—Virginia cigars.
Küstel, Guido, San Francisco, Cal.—Fruit with galvanized coating.
Landers, Frary & Clark, New Britain, Conn.—One set of carvers.
Leeds, Lewis W., New York.—Drawing for ventilation and heating of school-houses.
Leiser, Emma, Brooklyn, N. Y.—Embroidered picture.
Leslie, James, Cincinnati, Ohio.—Crystalline gold for dentists.
Lindemann, O., & Co., New York.—Bird-cages.
Lippincott, J. B., & Co., Philadelphia, Pa.—School publications.
Lowell Institute, in Boston, Mass.—Dissemination and promotion of science.
Maddox, Hobart & Co., Cincinnati, Ohio.—Case of gin.
Marcou—Geological maps.
Marsh Harvester (the) Manufacturing Company, Sycamore, Ill.—Sulky corn-plow and cultivator.
Mathews, John, New York.—Patent tumbler-washer.
Merrell & Soule, Syracuse, N. Y.—Packed fruit and provisions; fresh tomatoes, sweet corn, and apples.
Miller, Samuel A., Cincinnati, Ohio.—Hand-machine for making stove, drain, and other pipe elbows from one piece of sheet metal.
Milwaukee Chamber of Commerce.—Exhibition of hops and grains.
Mineral City Mining and Smelting Company, Mineral City, Ill.—Lead ores, fluorspar, and case of minerals.
Mitchell, J. E., Philadelphia, Pa.—Grindstones.
Murdock, August J., New York.—American mustard.
Nathan & Dreyfus, New York.—Lubricators' oil-cups.
New Orleans Sanitary and Fertilizing Company, New Orleans, La.—Pelican fertilizer or American fixed guano.
Newton, Mass.—School reports and educational statistical charts.
New York Safety Steam-Power Company, New York.—Two vertical steam-engines, one of ten and one of four-horse power, for use in the American department of the Exhibition.
Nichols, S. W., Boston, Mass.—Wall-desk.
Nye, W. F., New Bedford, Mass.—Sewing-machine and match oil.
Phillips's Spiral Husker Company, Hudson, N. Y.
Pitkin Brothers, Hartford, Conn.—Forty-horse power cylindrical tubular boiler, for supplying steam to the American department.
Pratt, Charles, Vermont.—Brass oil-cans.
Reck, Henry, of Reck & Dannot, architects, New York.
Reversible Boot-Heel Company, Providence, R. I.—Boot-heel machine.
Ross, Lester E., Providence, R. I.—Picker-motion for looms.
Royal Chemical Company, New York.—Essences of fruits.
Russell & Erwin Manufacturing Company, New Britain, Conn.—Sample card of bronze and hardware.
Rykoski, J., New Orleans, La.—Black Louisiana moss.
Saint Louis, Mo.—Educational statistics, &c.

Schillinger, John J., New York.—Introduetion of eement pavement in New York.

Sehuyler, Hartley & Graham, New York.—Saddles.

Schwind & Kruger, New York.—Life-size photographs.

Seribner, Armstrong & Co.—Publishers of Guyot's maps.

Seth Thomas Clock Company, New York.—Clocks.

Shattuck, G. W., Boston, Mass.—School desks and seats.

Sherman, W. B., Boston, Mass.—Spades and shovels.

Schultz, Southwick & Co., New York.—Sole-leather, (union erop and hemlock.)

Simon, Edward, & Brothers, Newark, N. J.—Trunks and traveling-bags

South Haven Pomological Society, Saint Louis, Mo.—Dried fruits by Williams's process.

Spahn, Emil P., Newark, N. J.—Photographic eamera and attaehment.

Spillman, Henry, New Orleans, La.—Abdominal supporters, trusses, and shoulder-braces.

Springfield, Ill.—School reports, edueational statistics.

Stearns & Foster, Cincinnati, Ohio.—Cotton waddings and battings.

Steck, Geo., New York.—Pianos.

Stevens & Brown Manufacturing Company, Cromwell, Conn.—Meehanical toys.

Stevenson Brothers & Co., Philadelphia, Pa.—Refined paraffine made from Pennsylvania petroleum.

Stewart & Kirkland, Jackson, Miss.—Wood and lumber.

Sweet, Barnes & Co., Syracuse, N. Y.—Mowing-knives and reapersickles.

Thalheimer & Hirsch, Philadelphia, Pa.—Shirts.

Thompson, Judson L., Syracuse, N. Y.—Waterproof paeking-cases for tobacco, waterproof packing for in-soles for shoes.

Toledo (Ohio) department of public schools, (D. F. De Wolf, superintendent.)—School reports, educational statistics, and examination papers.

Tuttle, George R., Cleveland, Ohio.—Specimens of ores from eaeh of the leading iron mines of the Lake Superior district.

Unnevehr, New York.—Photographs of reliefs.

Urbana Wine Company, New York.—"Sparkling Gold Seal" and "Sparkling Imperial."

Van Deusen Brothers, Kingston, N. Y.—Oil of wintergreen.

Van Loo, Leon, Cincinnati, Ohio.—Varieties of imperial and eabinet photograph portraits and groups from life.

Vose, Dinsmore & Co., Newark, N. J.—Wagon-springs and springs for earriages.

Walton Brothers, Newark, N. J.—Lanterns.

Warren, J. Q. A., New York.—Speeimens of American natural history.

Wilkins, Theodore, New York.—Moss and exeelsior.

Woreester City (Mass.) sehools, (Marble, superintendent.)—Sehool and statistieal reports.

70. *Medals and diplomas awarded American exhibits, by groups.*

Groups.	Number of exhibits.	Diploma of honor.	Medal of progress.	Medal of merit.	Diploma of recognition.	Medal for fine arts.	Medal for good taste.	Medal for co-operation.	Total awards.
I. Mining, Quarrying, and Metallurgy	36	.....	1	9	4	.....	.....	1	15
II. Agriculture, Horticulture, and Forestry	42	.....	1	3	5	.....	.....	.....	9
III. Chemical Industry	41	.....	.....	19	10	.....	.....	.....	29
IV. Substances of Food as Products of Industry	69	.....	9	25	17	.....	.....	.....	51
V. Textile Industry and Clothing	34	.....	2	20	5	.....	.....	.....	27
VI. Leather and India-rubber Industry	25	.....	1	4	10	.....	.....	.....	15
VII. Metal Industry	53	.....	1	7	16	.....	.....	.....	24
VIII. Wood Industry	13	.....	2	4	1	.....	.....	.....	7
IX. Stone, Earthenware, and Glass Industry	19	.....	.....	1	2	.....	.....	.....	3
X. Small Ware and Fancy Goods	10	.....	.....	1	1	.....	.....	.....	2
XI. Paper Industry and Stationery	17	.....	2	8	5	.....	.....	.....	15
XII. Graphic Arts and Industrial Drawing	36	.....	6	10	7	.....	3	2	28
XIII. General and Agricultural Machinery	151	3	33	29	25	.....	.....	18	108
XIV. Philosophical and Surgical Instruments	31	1	2	1	3	.....	2	.....	9
XV. Musical Instruments	6	.....	2	.....	2	.....	.....	.....	4
XVI. The Art of War	16	.....	1	11	.....	.....	.....	.....	12
XVII. The Navy	8	1	.....	2	2	.....	.....	.....	5
XVIII. Civil Engineering, Public Works, and Architecture	15	.....	1	2	6	.....	.....	.....	9
XX. The Farm-house, its Arrangements, Furniture, and Utensils	1	.....	.....	.....	.....	.....	.....	.....	.....
XXI. National Domestic Industry	2	.....	.....	.....	1	.....	.....	.....	1
XXIII. Art applied to Religion	2	.....	.....	.....	.....	.....	.....	.....	.....
XXV. Fine Arts of the Present Time	16	.....	.....	.....	.....	2	.....	.....	2
Total	643	5	64	156	122	2	5	21	375
Total awards for exhibited objects	.....	.....	.....	.....	.....	.....	.....	.....	349

71. *Table showing the medals and diplomas awarded to exhibits from the several States.*

State.	Number of exhibits.	Diploma of honor.	Medal of progress.	Medal of merit.	Diploma of recognition.	Medal for fine arts.	Medal for good taste.	Medal for co-operators.	Total awards.	Awards for exhibited objects.
Alabama	2	.....	.....	1	.....	.....	.....	.....	1	1
California	9	.....	5	4	.....	.....	.....	.....	9	9
Colorado	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Connecticut	23	.....	4	9	6	.....	.....	3	22	19
District of Columbia	6	1	.....	1	1	.....	.....	.....	3	3
Georgia	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Illinois	20	.....	.....	6	6	.....	.....	.....	12	12
Indiana	5	.....	.....	2	1	.....	.....	1	4	3
Kansas	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Kentucky	8	.....	.....	2	3	.....	.....	.....	5	5
Louisiana	65	.....	2	9	7	.....	.....	.....	18	18
Maine	1	.....	.....	1	.....	.....	.....	.....	1	1
Massachusetts	55	.....	13	15	5	.....	.....	1	34	33
Maryland	4	.....	.....	1	2	.....	.....	.....	3	3
Michigan	2	.....	.....	.....	1	.....	.....	.....	1	1
Missouri	33	.....	1	4	4	.....	.....	.....	9	9
Mississippi	3	.....	.....	.....	1	.....	.....	.....	1	1
Nevada	1	.....	.....	1	.....	.....	.....	.....	1	1
New York	216	1	23	55	56	1	4	9	149	136
New Jersey	15	.....	2	3	6	.....	.....	.....	11	11
North Carolina	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ohio	86	.....	7	21	10	.....	1	7	46	38
Pennsylvania	43	2	4	13	6	.....	.....	.....	25	25
Rhode Island	12	1	2	4	2	.....	.....	.....	9	9
Tennessee	3	.....	.....	1	.....	.....	.....	.....	1	1
Texas	1	.....	.....	1	.....	.....	.....	.....	1	1
Virginia	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
West Virginia	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Vermont	9	.....	.....	.....	1	.....	.....	.....	1	1
Wisconsin	2	.....	.....	1	2	.....	.....	.....	3	3
Miscellaneous	10	.....	1	1	2	1	.....	.....	5	5
Total	643	5	64	156	122	2	5	21	375	349

THE INTERNATIONAL EXHIBITION AT VIENNA, 1873.

PART II.

EXTRACTS

FROM

OFFICIAL FOREIGN REPORTS

REFERRING TO

EXHIBITS FROM THE UNITED STATES.

PREFACE.

The abstracts from the official reports of members of the International Jury and of the commissioners of foreign nations which are here given have been collated from official documents furnished the Editor by the Department of State.* They are necessarily incomplete in consequence of the fact that, in several instances, the complete series had not been issued from the foreign printing-offices.

The Austrian and German reports are nearly complete. The British and French reports have been some time in print. The Swiss reports are now issuing from the press.

Referring to the reports of the Commissioners of the United States, which are presented in succeeding volumes of this series, it will be noticed that many important subjects remain unnoticed by official reporters, and that other departments have not received as complete examination and criticism as would have been desirable. This fact, which, unfortunately, was entirely unavoidable, is a consequence of the circumstances referred to in the report of the Chief Executive Commissioner, the Hon. H. Garretson. The distance of the Exhibition from the United States; the seemingly slight interest held by American manufacturers in the European markets; the absence of information among our people relative to the character, resources, and requirements of the Western European nations; the time, expense, and annoyances incident to the transportation of goods, despite the liberality of both our own and the Austrian government; the more serious expenditure of time and money demanded in the proper exhibition and personal representation of the merits of contributors; the unfortunate condition of the Austrian patent laws and regulations, which gave little security against piracy—all these circumstances prevented a full and fair representation of the industries of the United States at Vienna. All of these circumstances also had weight, directly or indirectly, in

**Officieller Ausstellungs-Bericht, herausgegeben durch die General-Direction der Weltausstellung, unter redaction von Dr. Karl Th. Richter, K. K. O. Ö. Professor an der Universität zu Prag;* Wien, 1873.

Reports on the Vienna Universal Exhibition of 1873, presented to both Houses of Parliament by command of Her Majesty; in four parts; London, 1874.

Exposition Universelle de Vienne en 1873; France, commission supérieure; rapports; Paris, 1875.

Amtlicher bericht über die Wiener Weltausstellung im Jahre 1873; *erstattet von der Centralcommission des deutschen Reiches für die Wiener Weltausstellung;* Braunschweig, 1875.

Exposition de Vienne, 1873; *Suisse; Rapports sur les Groupes I, II, etc., etc.;* Schaffhausen, 1875, etc., etc., etc.

preventing such an attendance at Vienna of men of eminence in science or in art, and of leading experts in the various branches of industry, as would otherwise have been seen. The variable and unhealthy climate, the prevalence of cholera, and the apparent imminence of danger of a great epidemic, together with other equally well-marked causes, also aided to prevent those who did visit the *Ausstellung* from making a long stay.

It thus happened that it was impossible to secure that complete survey of the ground and that thorough consideration of the whole collection that was most important. Reporters could only be found for a limited number of the nearly thirty groups into which the exhibits were classed; and, in many cases, the limited time taken for study prevented as full an examination and as extended reports as the reporters themselves could have desired.

Some of the marked omissions here alluded to were, however, due to the fact that progress, whether in science, art, industry, or literature, is never regular in its pace, and is never found to pervade equally all departments. At Vienna, in 1873, some departments exhibited most important and most radical changes and advances, sometimes amounting to revolutions. In other classes there had been no noticeable progress since the Paris Exhibition of 1867. In such cases, the reporter found little or nothing to report.

In some cases, therefore, there were no reporters familiar with certain classes of exhibits; and in others, the reporters could only state the fact that no important advance in methods and no important discoveries had been made since 1867; and in such instances the reports of the commissions exhibit a perfect blank where, frequently, much was expected. In other departments a long and very thorough study of exhibits has shown great advances, important discoveries, and immense development of industries; and the reports are, in consequence, extended, exhaustive, and very valuable.

Where the deficiency alluded to is a consequence of the absence from among the Commissioners of the United States of experts competent to consider the division which is conspicuous by its absence from the list of subjects reported on, it has been found possible, in many instances, to supply the omission by quotation from foreign reports in which the subject has been intelligently treated. This has been done to a limited extent with the result, it is hoped, of very greatly increasing the value of this collection.

The reader of a series of reports like this, in which all subjects considered are necessarily treated from a stand-point which renders the most fair-minded and intelligent critic liable to the suspicion, if not to a just accusation, of taking a favorable bias from the natural pride felt by every citizen in seeing and aiding the success of his countrymen in these grand international competitions, will feel that it would be both satisfactory and profitable to be able to read the comments of foreign critics

pon the exhibits which were representative, at Vienna, of the industries nd progress of the United States. Such criticisms have the greater alue from the fact that they are, in all cases, made by experts whose ames are familiar as those of the greatest authorities in Europe in their espective departments, and are acknowledged here, as well as abroad, s such.

The translations have been made less with the aim of securing elegance f style or literary merit than with the intention of reproducing accu-ately the meaning of the foreign critic. They sometimes, therefore, read somewhat roughly and are entirely deficient in that rhetorical ex-cellence which might have been secured by freer translation and more frequent substitution of the English for the foreign idiom. This defect is, in the judgment of the Editor, more than compensated by the greater accuracy with which the meaning of the writer has been reproduced.

It will be observed that the foreign critic is not always complimentary in his allusion to our products or to our methods, while, in rare instances, the opinion expressed is quite the reverse. It has not been the intention of the Editor to expurgate the work of any reporter from either side the Atlantic; although he has not hesitated to omit all that was plainly erroneous, or which appeared to be prejudiced. Happily, but little of the latter feeling is found among the intelligent men chosen by foreign nations to represent them at Vienna.

Such adverse criticism as may be noted will prove undoubtedly instructive and profitable to our own people. It is an opportunity to learn the position which we hold in the opinion of other peoples such as is rarely offered.

It is a subject of congratulation and will be a source of real pleasure to every citizen of the United States that these criticisms are so generally favorable. They are even, in fact, more favorable than they, at first glance, might appear. In reading them, it is to be remembered that the foreign writer—born and bred in distant countries, under influences with which the citizen of the United States is unfamiliar, and from which he is fortunately free, accustomed to habits of thought, and familiar with methods which are equally strange to those whose work he criticises, viewing the subject of his criticism from an entirely different stand-point, and through a medium of very different hue—must necessarily be placed at some disadvantage. He cannot be expected to see the real value of American methods or of American productions, taken apart from the peculiar circumstances which have brought them into existence. The real bearing of the distinctions arising between the older nations of the Eastern continent which are slowly progressive, stationary, or even retrograde in their changes—in which conservatism and tradition have almost absolute sway; in which ambition is stifled before the citizen reaches the age of manhood, by the evident and almost absolute impossibility of advancement, except as the death of those already occupying them opens new opportunities at home;

and migration to another land is the only alternative, with a life of laborious poverty and obscurity; where every effort at progress is difficult—and the young nation which is barely a century old, and in which ambition, energy, and character have open field and a full reward, is not, and cannot be, appreciated by those who have seen and felt only one of these two opposite sets of conditions. Still less is it possible for the man who has been subjected to the one to criticise the methods and the work of the man who has labored under the other, until he has seen and felt and intelligently studied the circumstances controlling the latter.

It is to be remarked that the views of European reporters are fair and generally favorable in tone. It seems evident that there exists among the influential classes of Europe, as well as among those less favored, a feeling of decidedly friendly prejudice which even the radical differences of circumstance and training alluded to above has not seriously repressed.

R. H. THURSTON.

METROLOGY.

72. TABLES OF AUSTRIAN, ENGLISH, AND FRENCH MONEY, WEIGHTS, AND MEASURES.

I.—MONEY.

In calculating the following tables the pound-sterling is taken at 10 florins Austrian silver standard, *(Conventions Münze,)* or 25 francs.

The Austrian monetary system is paper currency.

The rate of exchange varies according to the rise and fall in the price of gold. But in the Austrian Empire, a florin, or *gulden*, is always a florin, viz, 2 shillings silver.

The Austrian waehrung (paper currency, which is legal tender) is likewise continually subject to important fluctuations. It is, on an average, 5 per cent. less in value than the usual *Conventions Münze;* so that the florin in Austrian waehrung would have the average value of 1*s.* $10\frac{8}{10}$*d.*

Accordingly, the value of the current gold and silver coins is:

	£	*s.*	*d.*
5 kreuzer = $\frac{1}{20}$ part of a florin	0	0	$1\frac{1}{2}$
10-kreuzerpiece = $\frac{1}{10}$ part of a florin	0	0	$2\frac{2}{6}$
20-kreuzerpiece = $\frac{1}{5}$ part of a florin	0	0	$4\frac{4}{6}$
25-kreuzerpiece = $\frac{1}{4}$ part of a florin	0	0	6
50-kreuzerpiece, or 10 silber-groschen	0	1	0
1 florin, or gulden, silver	0	2	0
1 thaler (dollar) = 1 florin, 50-kreuzer	0	3	0
2-thalerpiece = 3 florins	0	6	0

Gold:

4-florinpiece = 10 francs	0	8	0
8-florinpiece = 20 francs	0	16	0
1 krone (crown) = 13 florins, 80 kreuzer	1	7	7
$\frac{1}{2}$ krone (crown) = 6 florins, 90 kreuzer	0	13	10
1 ducaten (ducat) = 4 florins, 80 kreuzer	0	9	7
1 doppel-ducaten (double-ducat) = 9 florins, 60 kreuzer	0	19	3

Paper currency, present rate of exchange:

100 kreuzer = 1 florin; 1 florin or gulden	0	1	$10\frac{1}{2}$
5 florins	0	9	$4\frac{1}{2}$
10 florins	0	18	9
50 florins	4	13	9
100 florins	9	7	6

The notes issued by the Austrian National Bank are respectively 1,000,

100, and 10 florin notes. Those issued by the Imperial Treasury are respectively 50, 5, and 1 florin notes.

Value of English coins in Austrian money:

1 sovereign = 10 florins Austrian currency in silver.
½ sovereign = 5 florins Austrian currency in silver.
5-shillingpiece = 2 florins 50 krenzer Austrian currency in silver.
Half-crown = 1 florin 25 kreuzer Austrian currency in silver.
1 florin = 1 florin Austrian currency in silver.
1 shilling = 50 kreuzers Austrian currency in silver.
6-pennypiece = 25 kreuzer Austrian currency in silver.
4-pennypiece = 16½ kreuzer Austrian currency in silver.
3-pennypiece = 12½ kreuzer Austrian currency in silver.
1 penny = 4 kreuzer Austrian currency in silver.
¼-penny = kreuzer Austrian currency in silver.
1 farthing = 1 krenzer Austrian currency in silzer.

II.—WEIGHTS AND MEASURES.

By the law of 25th July, 1871, promulgated in the Imperial Law Repertory of the 2d of March, 1872, the metric system of weights and measures has been legalized in Austria. Its use has been rendered permissive from the 1st of January, 1873, and it will become obligatory from the 1st of January, 1873.

Accordingly, the *measures of length* will be:

The meter as unit.
The decimeter = $\frac{1}{10}$ meter.
The centimeter = $\frac{1}{100}$ meter.
The millimeter = $\frac{1}{1000}$ meter.
The kilometer = 1,000 meters.
The myriameter = 10,000 meters.

The measures of surface:

The are = 100 square meters.
The decare = 10 ares = 1,000 square meters.
The hectare = 100 ares = 10,000 square meters.

The measures of capacity:

The litre = 1 cubic decimeter.
The decilitre = $\frac{1}{10}$ litre.
The centilitre = $\frac{1}{100}$ litre.
The hectolitre = 100 litres.

Weights:

The kilogram = (2 zollpfund) as unit.
The decagram = $\frac{1}{100}$ kilogram.
The gram = $\frac{1}{1000}$ kilogram.
The decigram = $\frac{1}{10000}$ kilogram.
The centigram = $\frac{1}{100000}$ kilogram.
The milligram = $\frac{1}{1000000}$ kilogram.
The ton = 1,000 kilograms.

Comparative table of measures and weights at present in use.

A.

I.—MEASURES OF LENGTH.

Austrian.	English.	French.
1 ell (Vienna) à 29.578 inches	= 2 feet and 6.67 inches	= 0.777 metre.
1 ell (Bohemian) à 22.548 inches	= 1 foot and 11.35 inches	= 0.592 metre.
1 foot (Fuss) = 12 inches, (inch = 12 lines)	= 1.0371 feet	= 0.316 metre.
1 fathom (Klafter) = 6 feet	= 6 feet and 2.0742 inches 2 yards and 2.67 inches	= 1.896 metre.
4,000 Klafter = 1 mile.		
1 mile (post = 24,000 feet)	= 8,297 yards = 4.7142 miles	= 7.585 kilometres.
1 inch (Zoll) = 12 lines	= 1.0371 inches	= 0.026 metre.

II.—MEASURES OF SURFACE.

1 foot (square) = 144 square inches	= 1.07 square foot	= 0.001 are.
1 yoke (Joch) = 1,600 square fathoms = (quadrant Klafter)	= 5.68 roods = 1.42 acres	= 1.576 hectare.
1 yoke (Hungarian forest measure) = 1,200 square fathoms	= 4.26 roods = 1.06 acre	= 57.546 ares, or = 0.575 hectare.
1 fathom (square, quadrant Klafter) = 36 square feet	= 4.28 square yards	= 0.036 are.
1 mile (square)	= 14,200 square acres	= 5,755.6 hectares.

III.—MEASURES OF CAPACITY.

1 foot (cubic) = 1,728 cubic inches	= 7.0 gallons	= 31.6 litres.
1 fathom (cubic) = 216 cubic feet	= 23.6 quarters	= 6,822.4 litres.
1 metza = 16 maassel = 19,471 cubic feet	= 13.6 gallons	= 61.5 litres.

IV.—MEASURES OF LIQUIDS.

1 eimer (beer) = 42½ maass	= 13.2 imperial gallons	= 60.0 litres.
eimer (wine) = 41 maass	= 12.76 imperial gallons	= 56.6 litres.
1 maass (Vienna) = 2 Kannen	= 1 quart and ½ pint = 0.3114 imperial gallon	= 1.41 litres.
1 Kanne = 2 Seidel	= 0.1557 imperial gallon.	

V.—WEIGHTS.

1 loth = 4 quentchen	= 270.2 grains = 0.0386 pound	= 0.017 kilogram.
1 pound (Vienna Zollpfund*) = 32 loth =	= 1.23 pound = 1 pound 3 ounces 11 drachms	= 0.560 kilogram.
1 pound (tariff)	= 1.10 pound = 1 pound 1 ounce 10 drachms	= 0.50 kilogram.
1 cwt. (Vienna Zentner) = 100 pounds as used in trade = 5 stone	= 123.0 pounds 7 ounces 5 drachms	= 56 kilograms.
1 cwt. (tariff)	110.0 pounds 3 ounces 10 drachms	= 50 kilograms.

* The "*Zollpfund*" is equal to ½ kilogram or 500 grams; 100 "*Zollpfund*" make a "Zoll-Zentner" (hundred-weight) = 50 kilograms.

B.

English-Austrian.

I.—MEASURES OF LENGTH.

1 fathom = 5.78 Vienna feet.
1 foot = 0.96 Vienna foot = 11.57 Vienna inches.
1 furlong = 106.06 Vienna fathoms.
1 league = 979.2 Vienna fathoms = $\frac{7}{10}$ miles.
1 mile (English) = 804.86 Vienna fathoms = 1,666 yards.
1 mile, statute, = 847.7 Vienna fathoms.
1 pole, perch, rod = 2.65 Vienna fathoms.
1 yard = 2.89 Vienna feet = 1.174 Vienna ells.

II.—MEASURES OF SURFACE.

1 acre = 1,124.93 Vienna fathoms square.
1 foot square = 133.9 Vienna inches square.
1 rod, square pole = 7.02 Vienna fathoms square.
$\frac{1}{4}$ acre = rod acre = 281.288 Vienna fathoms square.
1 yard square = 8.35 feet square.

III.—MEASURES OF CAPACITY.

1 bushel = 0.59 Austrian metzen.
1 chaldron = 21.27 Austrian metzen.
1 gallon = 3.21 Austrian maass.
1 last = 47.27 Austrian metzen.
1 pint = 1.60 Austrian seidel.
1 quart = 3.20 Austrian seidel.
1 quarter = 4.73 Austrian metzen.
1 sack = 1.77 Austrian metzen.
1 wey = 23.63 Austrian metzen.

IV.—MEASURES OF LIQUIDS.

1 gallon = 3.21 Austrian maass.
1 pint = 1.60 Austrian seidel.
1 quart = 3.21 Austrian seidel.

	Wine. Spirits. Cider. Vinegar.	Ale.	Beer.
	= Austrian eimer.		
1 barrel	.....	2.57	2.89
1 butt	10.11	7.70	8.66
1 firkin	.....	.....	0.72
1 hogshead	5.05	3.85	4.33
1 kilderkin	.....	1.28	1.44
1 puncheon	6.74	5.14	5.78
1 runlet	1.44	.....	.....
1 tun	20.23	15.42	17.34

V.—WEIGHTS.

1 drachm = 0.10 Vienna loth.
1 cwt. = 90.72 Vienna pounds.
1 pound = 0.81 Vienna pound = 25.92 Vienna loth.
1 quarter = 22.68 Vienna pounds.
1 stone = 11.34 Vienna pounds.
1 ton = 1,814.4 Vienna pounds.
1 ounce = 1.62 Vienna loth.

C.

French-Austrian.

I.—MEASURES OF LENGTH.

1 kilometre = 1,000 metres = 527.25 Vienna fathoms.
1 metre = 10 decimetres = 100 centimetres = 1,000 millimetres = 3.1635 Vienna feet = 1.28 Vienna ells.
1 myriametre = 10,000 metres = 5,272.4 Vienna fathoms.

II.—MEASURES OF SURFACE.

1 are = 27.80 fathoms square.
1 hectare = 2,780 fathoms square = 1.7375 yoke.

III.—MEASURES OF CAPACITY.

1 hectolitre = 10 decalitres = 100 litres = 1.6259 Austrian metzen.
1 litre = 0.130 Vienna achtel = 0.26 Austrian maass.

IV.—MEASURES OF LIQUIDS.

1 litre = 10 decilitres = 100 centilitres = 0.71 Vienna maass = 2.83 Austrian seidel.

V.—WEIGHTS.

1 kilogram = 10 hectograms = 100 decagrams = 1,000 grams = 1.7857 Vienna pounds = 1 pound 25.14 Vienna loth.

EXTRACTS

FROM

BRITISH REPORTS

REFERRING TO THE

EXHIBITS OF THE UNITED STATES

AT THE

INTERNATIONAL EXHIBITION, VIENNA, 1873.

GROUP XIII.

MACHINE-TOOLS, TEXTILE AND OTHER MACHINERY.

(Report of J. ANDERSON, Esq., C. E., LL. D., &c.)

* * * * * *

73. Although the British machinery occupied a much greater space than was required by the American display, yet, taken as a whole, there was not (whatever may be the explanation) a proportionate amount of new idea brought forward. The trade-disputes of late years must have had a prejudicial and withering effect upon the minds of men who have the thinking part of the duty to perform, and the tendency of such disturbing influences is to dry up the spring from which invention flows. The class of machine-tools that are employed in working wood was the most conspicuous exhibit in the British section, both for extent and variety. In this branch of machinery we came out nearly in full strength, and, what was more to the point, our exhibitors were not afraid to work their machines.

The British modern wood-machinery may be said to be almost entirely the work of the past twenty years. The few remains of the wood-machinery which previously existed are now absorbed in the more modern tools by the gradual development of the principle of natural selection. Many of the ideas of Bentham, Brunel, and Bramah have been made available and incorporated with new ideas, and some of the older notions have been dropped, being now unnecessary. In 1851 we were taken by surprise with a few simple machines for working wood, which came from America, and from them, in a great measure, was derived the impetus that has pushed this branch up to its present condition. This machinery will be referred to in the proper place, and more in detail if space permits; suffice it to say here that, as a whole, it was very good, and equal to the best in the exhibition, although, perhaps, not so perfect in some minute details as that shown by certain other countries. It was interesting to observe a slight changing of places among our leading houses, since 1867, in Paris; some are stationary, one has gone up at least one round of the ladder, while another is scarcely up to the former position, not due to design or arrangement, but to careless workmanship, gear working roughly, parts unbalanced and even out of truth, simply the result of negligence. In the department of machine-tools we were very deficient, more especially in regard to quantity put forward, and likewise in originality. To

the knowledge of the writer it need not have been so. There have been more cleverly designed tools and collateral inventions set to work in England since 1867 than there were in the Vienna Exhibition from all countries put together, even including America, which was the most prolific, but scarcely any of them were exhibited, and consequently the nation did not take the full credit for its deserts. The workshops of certain leading firms in England are being filled up with tools of a special kind, possessing great originality with regard to fitness for a purpose in the manufacture of general machinery, agricultural engines, small-arms, and a variety of other things, of which scarcely one specimen was sent to Vienna. But in none of the machine-tool collections from any country, excepting America, was there to be seen any extensive attempt at such fresh devices, nor did we show any of the new class of ordinary tools that are being introduced by those firms—lathes with four spindles, or four slide-rests, for example, which the more enterprising houses have in use—lathes that enable one man to turn and cut four screws at one operation. Had we done so, England would certainly have received some additional diplomas.

* * * * * *

74. The celebrated house of Sellers & Co., of Philadelphia, received the diploma of honor. Their tools possess more originality, although perhaps accompanied with more faults when very critically examined; but be that as it may, every article which they displayed takes rank with the best of its kind shown in this Exhibition, and altogether this American collection possessed more real novelty and attracted a greater number of admirers than that of any other firm in the machinery part of the building.

The two firms above referred to, (Sharp, Stewart & Co., of Manchester, and Sellers & Co., of Philadelphia,) the one English, the other American, are both typical machine-making houses of their respective nations, and they offer a strong resemblance and contrast; both have arrived so near to the summit of the tool art that it is difficult to say which of them stands the higher. Sellers & Co. show decidedly a greater exuberance of fresh design, but the devices introduced are sometimes less perfectly combined or arranged than they might be by other hands; and while the English firm shows comparatively little fresh ingenuity, yet every feature of their products bespeak the matured thought of the experienced engineer. To select for comparison one example, namely, the planing-machine which originated with Sellers & Co., but which was made and exhibited by each firm. Both of these planing-machines are nearly alike in their general character, but in some of the details the difference is considerable. For instance, the Messrs. Sellers crowd the driving-gear into the close vicinity of the most important part of the machine, where it must evidently be inconvenient and in the way of the workman; but the other firm, from its long experience, without sacrificing any of the essential points, has contrived to place the gear-

ing entirely out of the way of the attendant, thus making it, in general opinion, the better machine of the two. To many, the careful examination of the entire display of both firms was a real treat; the castings of both houses were works of art, to look upon which caused the breast of the beholder to heave with admiration; and, after a close scrutiny of the products of both firms, the general conclusion was that Sellers & Co., while showing greater refinement, descended lower than the English firm in some of the details, but that the latter, as a whole, sustained its reputation and excellence more uniformly.

75. As a general rule, America had the greatest number of new devices, but with the exception of Sellers, this country was in other respects not quite up to the European style or standard. Nevertheless, in the general opinion, the precision of the greater number of the American machines, especially in the extreme refinement of their details, was fully ahead of that of the best European ones, while some of the attempts at copying the English style in regard to solidity of construction were not so successful, sometimes approaching even to clumsiness, and consistency of character was not maintained throughout; at the same time, where the American firms adhered to the general style of their own country, their consistency was marvelous, although depending more on their intuition than on calculation. The many interesting products from that country had a distinct character, namely, that of originality; yet there was not much of a very remarkable nature, and, with some exceptions to be hereafter referred to, not of very great importance; but still their novelty, in combination with first-class workmanship, was most conspicuous; besides, the American novelties are not of the kind that emanate from the drawing-office; they are more the result of the quiet thinking of earnest, practical men; and however they may fail in other respects, it is not in regard to fitness for their intended purpose. The besetting fault of the second-class American houses is the attempt at finery, both in regard to form, and painting or ornamentation. No doubt the teaching of exhibitions will soon remove that tendency. By listening to the praise which was so freely bestowed upon the productions of Sellers, Platt, Sharp, Tangye Brothers, and some of the Chemnitz houses, the American machine-makers will soon learn that the inherent natural beauty of their own productions require no artificial adornment. This circumstance of America having a larger share of originality in her machine-compositions than any other nation, is not easy to account for; their display was not extensive nor particularly striking, but almost every article had some interesting feature which attracted the attention of students from all countries, and from our people they received more attention than was given to the exhibits of all the rest of the world. With the few exceptions already referred to, the American novelties were not important, but they were all improvements tending in a particular direction—precision and labor-saving—and in advancing the gradual triumph of the human mind over matter.

Why the American genius for originality should be so active is somewhat obscure, because the same kind of hard necessity, commonly said to be "the prolific mother of invention," exists elsewhere; it certainly is not due to scientific education, for America, in that respect, is at the present time far behind Germany. The latter country, in all the grandeur of her vast display, seems a barren wilderness in regard to invention when compared with America, and yet these Americans were mostly of the Saxon or Teuton stock, hard-headed, thinking men, and extremely modest in their pretensions. To meet with such clear-thinking, studious men, is one of the chief pleasures and advantages to be derived from international exhibitions, and helps to spread a civilizing influence, perhaps more than even the exhibition of the inventions of the world, to the passing public.

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76. The mode of working a slide-lathe, exhibited at Paris in 1867 by Sellers, of Philadelphia, is the best contrivance probably yet introduced for the special purpose; but here in Vienna there was not a single lathe furnished with this device, except from America, and the reason given for this omission was that it had been tried, but that the discs which grip the inner discs are apt to wear at particular parts, showing that the design only succeeds when having Sellers's refinement of workmanship and quality of material. It is a simple contrivance which enables a turner to obtain any rate of feed, without a change of strap or wheel-motion, by merely touching a handle, and it ought to commend itself to all tool-makers, who should continue to persevere until they overcome any such difficulty as that named above, in order to supply their customers with only that which is the very best for the purpose. There is not the smallest disgrace, but rather the contrary, for one house to accept and adopt any designs of another which they may consider superior to, or an improvement upon, their own. This is frequently and satisfactorily arranged by houses of the highest standing in all countries, and if it were the general rule, all disputes would be avoided.

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77. In thus referring to some of the noteworthy specimens shown by different nations, it is convenient to take them in the order which they occupied in the building, commencing with America, which was met with on entering. This position was surrounded with advantages and disadvantages, the former chiefly due to its securing the first attention of visitors, the latter from its exposures to the weather, whereby the more delicate machinery was sometimes considerably affected when the wind or rain was excessive.

One of the most striking inventions of modern times is Tilghman's sand-blast process, as exhibited at Vienna, which from its novelty commanded much attention and admiration. The disintegration of surfaces by a current of sand or other fine, sharp powder, is one of the latest discoveries in connection with tools, and opens up an entirely new field for

its application; the remarkable effect produced is based upon the fact that when glass, stone, or other hard substance is subject to the impact of a blast of sand, the detrition of the surface is rapidly effected. The fact has been observed for a long time that windows exposed to the drift of sand by the sea-shore were gradually affected, until at length they could not be seen through; Mr. Tilghman has turned the idea to practical account, and with a large measure of success. At present, the process is chiefly employed to engrave devices upon plain or colored glass, which it executes both with precision and sharpness of outline. Although the sand acts so efficiently upon hard substances, still it has little effect upon soft or elastic materials; advantage is therefore taken of this circumstance to make the pattern of India-rubber, lace, and such like, which is spread over and gummed to the surface to be engraved, the blast of sand is then brought to bear across the pattern, and the whole of the bare surface is disintegrated, the depth depending upon the length of time to which it has been exposed to the blast. When hard substances are to be engraved to a considerable depth, it is found that the requisite velocity of sand-current is most easily obtained by the substitution of high-pressure steam for the blast of air; steam-pressure equal to 50 pounds on the square inch is employed; in using the air-blast, the pressure seldom exceeds one pound, and for fine work it is usually much less. If this process is found to fulfill all that is expected, we shall find it applied in many other directions, fluting stone columns, and finishing the carvings that are now made in granite and other descriptions of stone, because the sand-blast is applicable for the lathe, the planing and shaping machines, or wherever a steel instrument may be applied. Fortunately the idea has been developed at a most opportune time when the world is waiting for it, and hence its introduction is not likely to meet with any formidable opposition.

78. The finest collection from America was that of Messrs. Sellers & Co., of Philadelphia, which had perhaps the largest share of attention of any in the American department. Besides the machines that were shown in Paris by this firm, they had in addition several fresh devices of great interest. Their greatest novelty in tools was a small machine or implement for sharpening drills; this operation is usually accomplished in workshops by the workman holding the end of the drill against the side or periphery of a grinding-stone at the proper angle, the correctness of the operation depending entirely upon the man who manipulates the drill, and the consequence is that comparatively few drills run correctly when inserted in the drill-spindle, being generally found to wabble at the center-point more or less; hence, unless great care is employed there is no certainty of precision in the hole to be drilled, either as to position or dimensions; but in Sellers's drill-sharpening machine, the drill fits into a socket of the same shape as the machine-spindle, which is placed in relation to the emery-wheel at the proper angle, and then passes under the revolving emery, first upon one side and then upon the other,

and thus the drill is made perfectly correct for its purpose. The introduction of the emery-wheel instead of the stone, combined with the mechanism, is a great improvement, and the same principle will be found many times repeated in the more advanced portions of the Exhibition, more especially in France and Sweden. This system of grinding was introduced into England from America in 1854, and has been extensively employed at Enfield for sharpening circular cutters, but from some cause it does not find its way so rapidly into our general workshops as might be expected.

79. This firm again displayed their wheel-cutting machine, which cuts the teeth of wheels up to four feet in diameter, and is perfectly automatic when once set to work; by this means, it is said that one man can attend to the working of four machines, his office being simply to put in the blank wheels and take them out when finished as cut wheels. Looking at this machine as a mere combination of mechanical refinement, it was, as a workshop tool, unique, and received great and corresponding admiration. Their lathe likewise was almost perfect; the spindle seemed to float on a fluid, yet it was perfectly steady, and in working had not any of the jerking feeling that is usually to be found in the second-class lathes. The self-acting motion is obtained from the main gearing by means of a disk working between two disks on another spindle, but both on the same axis; hence, as the intermediate disk is nearer to, or farther from, the center of motion, so is the rate of motion that it receives. It is impossible to resist the conclusion that Messrs. Sellers were the most speculative tool-makers in the Exhibition, and everything that they showed was almost above criticism. Their bolt-screwing machine is now so well known in England, (being made by Sharp, Stewart & Co.,) that scarcely any word of praise or even description is required, but still the one shown at Vienna was a marvel of excellence; the fitting of the dies was perfection, yet withal so plain and simple, so free from every attempt at ornament, and yet so harmonious in its repose and in the full assurance of fitness for its purpose. Their planing-machine has been much admired on account of the smoothness of its action, the rack being worked by means of a worm or screw upon the end of an oblique shaft; by this arrangement the driving-gear is removed from the end of the bed and placed at the side, thus securing two important advantages by simple means. Their slotting-machine is somewhat peculiar, inasmuch as the sliding-bar does not slide in the frame as usual, but works in an intermediate slide-rest, thus giving facility either to lower or raise the intermediate frame to suit the work, in order to have the sliding-bar which carries the instrument under equally good conditions at all times, and thus give extra steadiness. A trifling feature in their tools is, that the sliding-bars of their countershaft arrangements are made of wood; they seem to answer the purpose as well as iron, and are of course both cheaper and lighter to manipulate.

80. A most remarkable article in the exhibit of this firm was a rotary

puddling-machine in which the puddling-vessel stands at right angles to a gas-furnace; the flame enters and leaves the vessel through one opening, passes from the side of the furnace through an opening upon one level, and after striking upon the liquid or viscous metal and doing its work, it returns through the puddler to a lower opening in the under part of the furnace, and thereby finds its way onward to the chimney. The puddling-vessel, in shape, resembles a large Carron pot, with the mouth smaller in diameter than the interior. This vessel is placed upon its side and mounted on rollers, in order that it may revolve freely; in one respect it differs from the pot, inasmuch as the bottom is hollow and filled with water, so as to protect that part from the effect of the intense flame to which it will there be exposed when in action as a puddler. The vessel is lined with oxide of iron or other suitable material, and worked by an independent steam-engine, which, at the word of command, is made to turn round in either direction, or, when required, the puddling-vessel will take any number of steps on the left backward wheel, thus giving free admission for the attendants to examine the interior, and with equal readiness it again closes up to the side of the furnace; the whole of these movements were performed, and in the entire exhibition perhaps there was not a more important novelty shown than this puddler, and the general opinion was that a great future lies before it.

The writer of this report, however, does not gives his full concurrence to this unqualified approbation, without further evidence of the practical working of the apparatus in the forge, fully admitting that it is a most ingenious and beautiful contrivance so far as regards its mechanism for the intended purpose; still it would yet seem to be puculiarly exposed to many contingencies in working it as an iron-making furnace, and hence it must not only be considered as a mere tool or machine like a lathe, but as a machine which will necessarily be exposed to an intense heat that will probably effect its working efficiency when considered merely as a machine. The cast-iron hollow vessel will be liable to warp and get out of form, and thus become unfit to turn round freely, or by the carelessness of the fettler when lining it from time to time, it may have a hole burned through the side at any moment; the fact that it is made of cast iron would alone seem to open up a list of contingencies to which it is necessarily exposed from hour to hour; had it been constructed as an annular vessel, and the sides filled with a continuous circulation of cold water similar to the bottom, the chances of success would have been more evident; besides, it is difficult to see how the face of the furnace against which it will have to rub is to be maintained in its integrity. The hope of luting with clay is inadmissible, and doubtless the slag will find its way to the vicinity of the joint, and occasionally clog the movement, thus causing it to stick fast, rendering it necessary to use a cowbar with force to disengage the vessel from the face of the furnace, and incurring great risk of fracturing the deli-

cate mechanism as the stickfast condition approaches; and in addition it is a very expensive arrangement, having to compete with others more simple. Of course the puddler could not be worked in the Exhibition building, but it was supplied with steam so that it could go through all its paces. This it did in the most perfect manner, and great interest was excited in regard to its future behavior when set to work for its living as an iron-puddler.*

81. This house had likewise a very perfect and carefully considered Nasmyth hammer, in which, by a simple arrangement of a loosely fitting circular valve, they control the resistance of exhaust in order to moderate the blow; they likewise showed a particularly simple method of fixing the removable portion containing the face of the hammer to the hammer proper, all being done by boring and turning, and by the agency of an intermediate annular wedge in halves, the whole secured by a side wedge; by this system, and with the aid of a wooden mallet, a change is made with but little trouble, and the security is certain.

From the foregoing short description it will be seen how rich this house is in mechanical resources; to do them full justice would occupy more space than is occupied by the entire report. This is a pattern house for machine tool-makers to study. At every exhibition it brings forth things new and old, and, as a rule, all thoroughly well considered, even in the most minute detail, so far as mechanism is concerned, more so than many firms which adhere to the most hackneyed description of the ordinary sorts of tools, and continue to make them from year to year without regard to improvement; and it was a source of satisfaction to observe the extreme interest with which our young men lingered around the exhibit of Sellers & Co., admiring the good points and keenly discussing the merits of the puddling-machine from the iron-maker's point of view.

82. There is an extensive manufacture in America of a small class of machine-tools quite characteristic of the country, and thoroughly distinct from the machines of any other nation used for the same purposes, although other nations are now adopting them by slow degrees. These American machines are distinguished by great refinement in the workmanship, but as a rule, without much design in the arrangement. In 1851 this country first became alive to the fact when Colonel Colt set up his factory at Pimlico, and in 1854 the writer brought over from America an immense variety of such machines for all sorts of purposes, more especially for the Enfield factory of small-arms. In the Vienna Exhibition the American houses came out strongly with an extensive variety of such tools intended for all purposes in connection with the manufacture of sewing-machines, of small-arms, and for producing the finest class of instruments of every kind, such as circular cutters, twisted drills, steel squares, and other things innumerable. Two houses in par-

* This invention has been several years in successful use at the iron-works of the proprietors at Edgemoor.—Ed.

ticular had each a grand display, namely, Pratt & Whitney, of Hartford, United States, and Brown & Sharpe, of Providence, United States. It is difficult to say which had the best products; both were first class in all essential particulars; the workmanship was a treat to look upon, and the liberality with which these houses distributed their books and photographs showed that they were not afraid of competition.

83. For some reason, English tool-makers, as a rule, do not go in for the particular refinement that lies at the root of the American system, more especially in tracing out the intricate figure from a copy, partly by the shape of the instrument, and partly by some modification of the figure having to be passed over, either by the instrument or by the holder containing the piece of metal to be operated upon, as in bridge-milling. A study of this system opens up a wide avenue leading in all directions; our lathes, planing-machines, and other tools in great measure restrict our forms to circles, curves, straight lines or cones, and a few other forms, within which, in the production of the heavier class of machinery, men strive to bridle their wants; but the American system of tools gives a greater latitude, as for examples, in producing the constituent parts of the lock of a musket, each of which is formed and left by the tools so accurately as to make the parts of the musket really interchangeable, even to the hundredth of an inch in every dimension, and with these contrivances neither the form nor the dimensions are dependent upon the immediate attendant. Our young men should study this system, because it offers a fine field of usefulness to those who are patient and ingenious. It was observed at Vienna that both Sweden and Germany are alive to the system, and made a fair display of some of the more common articles of the lathe and milling class; it is only when customers are refined in their notions and requirements that the more recondite machines of the American type are in demand.

84. The special novelties of Pratt & Whitney were more conspicuous in the adjustable holders of articles, their contrivances for sharpening intricate cutters by the solid emery-wheel, by using an index to show the depth of penetration of drills, and in the admirable manner of making small screws, every tool being permanently fixed. Their screw-making machine takes the rod of iron or steel, divides it into length for the required screw, turns, points, and screws it, and delivers it ready for the slit. In screwing it is so arranged that on touching a stop it reverses itself, runs back, and brings up the steel rod for the next screw. Similar ingenuity is introduced into their drills; where the hole has to be of a definite depth, an index is previously set correctly, which, when it touches a stop, causes the drill to draw out of the hole. Their machine for copying irregular forms performs its duty neatly and with precision. The same may be said of their drill-machines, containing several spindles, with a different drill for each of the various holes or countersinks in the article under operation.

85. The other firm of Brown & Sharpe had a perfect universal milling-machine, capable of performing at any angle or direction. Such a ma-

chine is an invaluable adjunct to any workshop; but, except in the War Department, this class of machine is rarely to be seen in our English factories; why, it is impossible to say. This house had, likewise, some very cleverly-devised small-tools for their machines. One, especially, was much admired; it was employed for cutting a screw-thread close up to a shoulder, and then to stop dead; certainly a delicate and difficult operation. It was a sort of chuck, consisting of two parts, the one sliding within the other. When in use the revolving head moves forward until it is stopped by a pin; then the inner part, holding the die, advances by the screw, which it cuts until it unlocks from the outer piece, and then merely revolves. The spindle-motion is then reversed, and the apparatus is drawn back by hand.

There were also shown most ingenious workshop-tools for slitting the heads of screws, for sharpening cutters of any description, and for other purposes. This collection was very rich in such ingenious devices, and was a very good place for every one to have any lurking conceit taken out of him in a most pleasant manner.

86. Jones & Laughlins, of Pittsburgh, made a strong impression upon the minds of European engineers with their cold-rolled shafting. It will be remembered that this invention occupied a good deal of attention in this country in 1859, when experiments were carried out by Sir William Fairbairn, which gave a good result in all respects, and improved the quality of material, both in regard to strength and stiffness, as well as in accuracy in parallelism and roundness. During the interval the invention has been assuming more and more importance in consequence of the growing price of labor, until at length the time seems to have arrived when this cold-rolled shafting will find its way into general use, not only for shafting, but for every class of articles that are straight and parallel and of whatever section. In the machinery of the textile manufactures, a wide field lies open for the production of such articles as are now finished by the lathe or planing-machine; besides, there are likewise a great variety of articles made out of plate-iron, where the improvement due to the condensation and smoothness will be of immense value; for such articles as spades and the like, that have to be strong, the increase of strength, due to the cold-rolling, in some cases was nearly equal to 100 per cent., and seldom under 50 per cent. This, therefore, is an invention that bids fair to make quite a revolution in the mode of arriving at the classes of articles above referred to, and will in time tend to the reduction of cost. A general summary of the results of experiments made in England at the works of Nasmyth & Co., by Sir William Fairbairn, is shown as below:

Condition of bar.	Breaking stress per square inch.		Strength, (the untouched bar being unity.)
	In pounds.	In tons.	
Iron in black condition untouched	58, 628	26. 173	1. 000
Rolled cold by this process	88, 230	39. 388	1. 505
When turned in a lathe	60, 746	27. 119	1. 036

87. Samuel A. Miller, of Cincinnati, exhibited one of the rudest pieces of mechanism that could be imagined—one of the kind of things that Robinson Crusoe would have made for his own convenience. It was placed in an out-of-the-way corner, as though it was of no account; but yet it was a gem of the first order. This machine was said to be for making stove-elbows; that is to say, a sheet of thin iron or tin-plate was given to the machine, which, by its mechanism, converted it into a pipe, and then bent the pipe into an elbow of fine curve and at right angles. To those who are familiar with the displacement of material, or gusseting, that is involved in bending such a thin pipe of sheet-iron, the necessary withdrawal of the metal from the inside of the bend, the disposal of that surplus, and the formation of a perfectly-curved bend, which would take a skilled man hours to accomplish, will readily see that it is a great feat to achieve. This machine, by a few turns of a handle, takes the plate, folds it into a tube, bends it, and crimps the folds of the inside into a uniform series of neatly-laid gussets. This apparatus, although a rough diamond at the present time, has a future before it. Mr. Miller must, however, put the construction of his machines into other hands, because, in addition to his mechanical genius, it requires the constructive art-knowledge which other men have been accumulating for hundreds of years.

88. Thomas Hall, of Northampton, Mass., exhibited a most admirable vise, which, in the opinion of all, was said to be the best yet seen. In construction it was parallel in its movement, but its chief feature was that it could be adjusted instantly and by one gentle motion. It is placed upon an automatic swivel, and is so arranged that the gripe of the vise likewise holds it fast in any position in relation to the bench. The griping-power is actuated by a short lever placed in front, and when the gripe is relieved the vise may then be drawn back with the other hand, the article inserted, and then pushed up to gripe, when the mere depression of the lever is at once sufficient to make all fast as a rock. From the circumstance that in outward appearance this vise resembled the eccentric vise with which we are all more or less familiar, the general impression was that it belonged to that order; but as the eccentric movement would not explain some of its peculiarities, a good deal of conjecture was bestowed upon its principle of action. As the proprietors did not at first seem disposed to show its interior to the public, in order to protect themselves for the present, this mystery added considerably to the interest, until at length they disclosed the secret, namely, that the motion was the old toggle-joint; certainly a most ingenious idea, and one which is most perfect in its action for this sort of purpose. All who know the action of the toggle are aware that as it approaches to the straight line the power is next to infinity, because it then produces scarcely any motion, while the friction at the points of movement of the toggle is almost *nil*. This vise is practically so good that it commended itself at once, and is sure to be taken

up in England very shortly, and unless it has some unseen defect will yet become an important addition to our labor-saving appliances in the workshop. Now that the toggle has been applied to this particular purpose, all are wondering that no one thought of it before; but so it is. In all our books which treat of this contrivance the merits of the toggle are discanted upon, the Stanhope lever is delineated, and its infinite power at a particular point is demonstrated, and shown to be the instrument most suitable wherever intense pressure is required with little motion. With almost everything else it is the same. The devices of the future are staring us in the face, but we do not see them until, one after another, they are thus turned to good account by some man more clear-headed than his neighbors.

89. Stiles & Parker Press Company exhibited a power-hammer worked by straps, which is a very convenient machine for situations where steam is not to be readily obtained; but otherwise there is not much to be said on its behalf. This firm likewise exhibited some good machines for stamping, cutting out, or forging metal; the chief and perhaps the most notable point in connection with them, was in the mechanism for adjusting, coining, or other dies, punches, or any other tool. In die-working it is especially of consequence that the surface may be adjusted even to a line of the thousandth part of an inch, which was here accomplished by the introduction of an eccentric into the structure of the connecting-rod, which, by a slight movement, adjusted the relative surfaces with the utmost nicety, yet without changing the distance that the connecting-rod will travel. This is accomplished by having introduced between the crank-pin and the hole in the connecting-rod an eccentric ring, with teeth cut upon its exterior for a worm, and having the worm fitted into the extremity of the connecting-rod, with a handle by which it can be regulated in its length with the utmost nicety, as in the case of a punch; as the point is ground away, the lengthening of the rod makes good the deficiency; all such trifles indicate great refinement, both in the conception of the idea and in practical working.

90. The firm of Darling, Brown & Sharp had a good collection of the class and sorts of tools for which Holtzapffel, of London, was long so celebrated; these tools were mostly small, circular cutters, gauges, steel squares, calipers, measuring-instruments, &c., all of the first class in regard to accuracy and workmanship, and modern in regard to style and adaptation.

91. Morse Twist Drill Company, of New Bedford, Mass. It may seem superfluous to notice the display of this firm, because they have been already referred to in the general part of this report; but it is necessary to do so because a great number of our workshops are still using the old drill. Why this should be the case, it is impossible to say. The old drill is a rude contrivance, only suited for a rude age; besides, it does not cut in the true sense; it merely scrapes by sheer pressure. These twisted drills of the Morse Company are real cutters, and bring

out shavings, which are worked out of the hole by the configuration of the drill. The display here made was a treat to examine; the drills were of all sizes, from that of a needle up to two inches in diameter, and they are largely manufactured, both for American use and for exportation all over the world, neatly arranged in cases like the Whitworth screwing-implements. Even this careful treatment of the drills has a refining influence. Drills are usually treated in a very different manner from taps and dies; but this ought not to be the case, and we shall do wisely to take a leaf out of the American book in respect to this really important matter.

92. A remarkable machine for compressing iron tires upon the periphery of ordinary wooden carriage-wheels was exhibited by James Barnes West, United States, and is well worth the attention of all who are interested in such articles. The usual method is to make the tire smaller than the wheel, then to expand it by heat, and, when sufficiently enlarged, to slip it over the wood, and by instantly immersing the wheel structure in water, to prevent charring of the wooden felloes, the tire cools and contracts. With Mr. West's machine the iron tire is forged sufficiently large to slip over the wheel in the first instance; it is then put into the embrace of this machine, which so acts upon it all round the circle that the iron is thereby constrained to upset into itself by a positive shortening of the ring without crumpling, and thus to gripe the wooden wheel. The mechanical arrangements employed to effect this object are extremely simple; they consist of a band or bands of steel or iron, made to form a true circle; one end of the steel band is a fixture, and is cut or fined away in such a manner as to admit of the loose end of the band going past it tangentially; the loose end of the steel band terminates in a powerful screw, with spur gear; the power is applied in the usual manner, thus reducing the circle, and drawing in the band around the wheel; consequently, a short hug is sufficient to produce the desired effect; the diameter was reduced one inch in less than a minute. Doubts were expressed in regard to the permanence of the effect, suggesting that the upset of the iron would relax in time and return to the original condition; but we have no warrant from our experience with other things to anticipate such a result. From the amount of interest which this machine excited among European exhibitors, and from the satisfactory manner in which it performed its office, it is probably one of the notabilities which will date back to the Vienna Exhibition; some of the British houses have already arranged with Mr. West for its manufacture in this country.

93. An interesting collection of pail or tub making machinery was exhibited in operation, by Baxter D. Whitney. This class of machinery originated in America at least a quarter of a century ago, and has been greatly refined by the exhibitor. In this manufacture the wood is first sawn up into planks the breadth of the staves, then cut into pieces of the proper length; these are again sliced into staves by a sheet cylindrical

saw with the teeth formed upon its extremity; the staves are now baked in an oven, then have the edges planed by a suitable machine to the required form, the pail is set up with a temporary hook and slipped upon a conical chuck, there held by an end-washer, plate, and bolt, and the hoop removed. A slide-rest tool is then passed along the exterior surface, the temporary hoop is again applied, and then pushed into a box chuck, another slide-rest tool is passed down the interior and finishes at one move. When at the bottom, the workman with the left hand in an instant moves another chisel to form the groove for receiving the bottom of the pail and finishes the upper edge. The boards for the bottom are planed on both sides in the ordinary sort of machine, then sawn into squares; the squares are griped between revolving plates and cut to the proper diameter by a parting tool, when a second tool bevels the edge to fit the pail, the time occupied for the entire operation being about five minutes. All the machines are specially made for their particular task, and it does one's heart good to see people going about their work in such a purpose-like manner.

Another machine for scraping wood was shown by this firm. In the application of machinery to plane wood, although we may congratulate ourselves on the rapidity, the general correctness, and especially in the cheapness of our productions, still there is a latent feeling that we are far from perfect—that we cannot equal the finished products of the best cabinet-work. In the American section a machine was shown in operation that not only equaled but surpassed the finest hand-planing. The sorts of wood acted upon were hard, and chiefly of the fancy kinds employed in cabinet work. The action of this machine was more of a scraping process than strictly planing, although it brought off a shaving like a sheet of tissue-paper, the entire size of the board, which it made as flat and smooth as a mathematical surface. In ordinary cabinet-work it is rare to see a mathematically true surface; the French varnish and a proper light shows the offensive uneven surface most conspicuously. As before said, this machine employed a scraper, which consisted of a thin blade of tempered steel, which was held in the machine by a suitable fixing, and in order to sharpen it had an emery-wheel passed over its scraping edge, the wheel being guided in a slide-rest; thus the edge of the scraper was straight in the strictest sense. The board to be scraped had been previously planed carefully by a planing-machine of the ordinary sort; it was then placed in the scraping-machine, which consisted of a series of carefully-prepared parallel rollers, top and bottom; the board being inserted between, a slow motion was given to the rollers, and the board then passed through (as solid as a rock) under the firmly-held scraper. At the first passage, or perhaps the second, and sometimes even the third, the shaving removed was not quite perfect; any defect in the shaving was an index of the imperfect surface of the board. At length it was absolutely perfect, the shaving being a transparent sheet of veneer. It will thus be seen that the essential condi-

tions are simple and attainable in different ways; the chief point is to get hold of the idea; the end of the clew will in time lead in many directions.

The same American collection contained a species of lathe for turning articles of wood which have to be frequently repeated, such as ornamental stair-balusters, the legs of tables or chairs, bed-posts, and such like. To turn the leg of a mahogany dining-table by the usual hand system is both tedious and expensive; it will take a good workman at least an hour to make it in accordance with the pattern, and even then it will not be exact in every particular. In this lathe the piece of wood is introduced, and is removed a finished article within one minute, and all to pattern. To cabinet-makers, who are not acquainted with what the rest of the world are doing with such machinery, this may seem a marvelous feat; but there are many more wonderful things of the same kind in our own country, and yet after all there is no magic. There is, first, the common lathe; between the head-stocks a sliding-frame is arranged and fixed to suit the dimensions; this slide contains two instruments, or knives, both the entire length of the article, the one knife to rough-out nearly to size in advance of the one to finish; both are set on the skew in order to take the work in detail; the first blade is merely to bring the piece of wood approximately to form, while the other blade is cut out exactly to pattern with all the irregularities of the required table-leg, and one single passage of the slide with its two instruments in moving past the revolving article is all that is necessary—the greater part of the minute being occupied in putting in and removing. It is only by the introduction of such machines for every kind of work that the world will be able to progress in these days. We require things to be good and beautiful, at the same time not expensive. For house-builders who employ round ornamental balusters, such a machine would be invaluable. Altogether, this entire collection was rich in original ideas for attaining high-class productions at the minimum of cost, and it deserved careful study.

94. For the past twenty years the attention of machine-makers has been directed to the production of a machine which should perform the work of dovetailing as neatly and securely as that of the skillful cabinet-maker. Many of the attempts were very ingenious, but none were entirely satisfactory until 1867. The first few months of the Paris Exhibition had run their course, when at last there appeared an American machine which took the machine-making world by surprise. It was the invention of Mr. Samuel Thomas Armstrong, of New York, and the execution of this new machine was so perfect in its action that the leading houses of all countries at once took it up, and a considerable number of the same class were to be found scattered through the Vienna collection. In the Armstrong machine the cutting-instruments are of the saw order, and are arranged upon an irregular circle, or, rather, helix, which, as it revolves, cuts out the dovetail spaces in succession with rapidity and considerable accuracy. It not only saws the two sides of

the dovetail, but it likewise saws or cuts out the pieces at the back, and cuts or saws out between the pins of the dovetail in a similar manner. It is, however, an expensive machine, and has to be constructed with care, or otherwise it is unsatisfactory; besides, any given helix saw will only cut one pitch of dovetail, but this it does very cleverly and snips out the piece to form a dovetail or a pin at one entire revolution, and works on by a self-acting movement. Previous to the coming of the Armstrong dovetailing-machine there were several approximate sawing-machines used for the purpose, rather imperfectly, that contained what was termed a "tipsy-saw," which, if made to wabble the required amount, would saw out the greater part of a dovetail; but to do so, the saw had to be slightly elliptical in order that the wabble should afford to the cutting-edge a true circle, which it could not do if made perfectly round. The "tipsy-saw" would, however, cut approximately any pitch or width by making it out of truth more or less; and the same for the pins. Taking advantage of the foregoing, an ingenious dovetailing-machine has been constructed in England, in which the saw is made "tipsy" by the mechanism; the spindle contains within itself the necessary elements of mechanism that are required to work out the geometry of the motion that is needful in the saw, both for the dovetail and the pin, all correctly to width and angle in every respect.

95. The Vienna Exhibition has brought forth from America another system of new machinery with the same object in view, but upon an entirely different principle of joining the wood and the mode of action. This entirely new device is now shown by Mr. Knapp, of Northampton, Mass., and is called a "dovetailing-machine, designed especially for cabinet and other fine work," but as the mode of joining has no resemblance to the tail of a dove, it will require another designation more in keeping with the system. The accompanying diagram will explain the principle of Mr. Knapp's system, and from which it will be seen, that in one of the pieces, a portion is removed by revolving hollow spindles, thus leaving pins on the solid wood; the other piece is correspondingly cut to shape by revolving cutters, combined with a series of drills to form holes for the pins; hence, if the tools are correctly combined, as they certainly were in the machine exhibited, then the junction of the two pieces of wood is both strong and perfect.

From the variety of opinion expressed, it is difficult to say whether this system will supersede the old method or not; in either case, it opens up to cabinet-makers a new field of inquiry, in order to see if even some more simple and less expensive mode of joining may not be devised and effected by a less costly machine than that of Mr. Armstrong. Mr. Knapp's system of tools points in the direction of economy, and much may be done, with well-directed thought, both to simplify the joint and the mode of forming it. Above all, keeping in mind that wood is not metal, we have no power over its production; it grows, and cannot be made; therefore, all our mechanism must be founded upon the charac-

ter of the particular sort of wood to be worked. The hard woods employed by Mr. Knapp were beautifully worked; but it is not certain that the softer woods used in Great Britain could be joined on this system.

96. An extensive plant of machinery for working wood was exhibited by C. B. Rogers & Co., of Norwich, Conn., constructed, perhaps, rather more in the English than in the American style; but, as a whole, it wanted character. Reference is, however, here made to it, chiefly on account of a rather good arrangement of the fixings whereby the instruments which require sharpening could be opened out at once, and without such a great amount of trouble as we frequently see to be involved; it only required the unfastening of a slip-bolt, and then the necessary parts could be moved out of the way upon the left pivot. The "get-atable" virtue is too lightly esteemed by many of our machine-makers. Next to thorough efficiency, this point should have the first consideration. This firm exhibited wood-planing machines of various sizes, but with a good deal of resemblance to our own, some of them rather pretentious in their style of construction, with a partiality for Gothic lines, and a strong trace of the drawing-office, although not entirely so. Sound, practical, good sense pervaded the majority of the machines. That some of their cutters, with a diameter of 4½ inches, make 3,800 revolutions per minute is probably the best praise that can be given; and if the parts will submit to such a velocity they must be very good. This house had a good arrangement for sharpening planing-knives, the same being fixed at the proper angle upon a holder, which can only be moved in a straight line across the face of the stone, thereby securing a good edge for the knife and at the same time keeping the stone in good order. A very cleverly-arranged machine for the formation of twisted balusters of any pitch or pattern was well worth attention. The piece of wood being first turned into a cylinder by another machine, is then pushed through a spindle which gives it the required pitch of screw; at the same time a circular cutter of the proper section running at high speed produces the pattern. They had likewise a good machine for wheel nave-mortising, with the necessary screw-auger to make an opening, and on a separate spindle was fixed the mortising-instrument; there was, however, so little novelty in many of these machines that it is scarcely necessary to notice them in detail, although the whole collection deserved careful inspection.

Several other American houses made a considerable display of wood-working machinery, all very good and simple in their arrangements, but there was nothing very original or strikingly conspicuous. One of the ribbon-saw machines had a hard-steel pin behind the smooth edge of the saw to give it support, and it was so arranged that as it became worn by the rubbing, it could be turned round to present a fresh bearing-surface to the saw, but whether this is better than the simple piece of wood or the steel roller is not easy to say confidently without a trial.

97. America did not show much in textile machinery, but what it did send over was of great importance. The most remarkable was a machine

invented by Mr. John Avery, of Massachusetts, for spinning short wool or cotton continuously, which was put forward as a substitute for the self-acting mule. The mule has long been celebrated as the most gentle device yet invented for spinning delicate yarn, in which the most conspicuous feature is a carriage containing the spindles that goes up to the delivering-rollers, gently leads off the thread, and communicates to it a certain amount of twist, which office it performs most admirably. The chief objection to the mule is the great amount of space that it requires on the floor of the factory, in order to give room for the carriage to run backward and forward; in this new machine the movement of a carriage is dispensed with, and the space occupied is similar to that of the ordinary throstle spinning-frame; consequently, a factory of given dimensions and cost would contain a correspondingly increased quantity of spinning-machinery. It would be premature to say whether this machine will realize all the delicate action of the mule; but, judging from the peculiarly gentle manner of treating the fragile thread, and its mode of action, it seemed to many very likely to be successful. There have been already several machines invented that were, in their day, expected to lead in this direction; both the Danforth and the Montgomery cotton-spinners were notably so, but the mule up to the present time, for the spinning of soft, fine yarn, has successfully held its own, because neither of those machines handled the yarn so delicately or secured the good points of the mule to the same extent as this new competitor. From the circumstance that some of our leading makers of textile machinery were in Vienna, and from the serious manner in which this new device was examined by them, there is no danger of its merits being overlooked; but from its importance, and the great question which it opens, it would be rash to arrive at a hasty conclusion. This machine claims to do more and better work with one-half the usual number of spindles, at less than one-half the expense, and to occupy less than one-quarter of the space; that it draws the yarn more evenly, and makes less waste than other machines. In this machine the roves of wool are drawn from a long reel of bobbins in the usual manner, but after a short space has been passed over, the rove, in the soft state, is held by an exceedingly ingenious reciprocating piece of mechanism, which gently draws out the untwisted portion within its hold, while the released part beyond is being continually twisted and wound into a cop upon a spindle. The mechanism of such an intricate machine as this can scarcely be made intelligible without diagram, and this the proprietor very properly withholds until the invention is fully secured by patent; but the most ingenious part is that which handles the rove as before referred to. When the rove leaves the bobbin, two gripping-wheels rise and fall from or upon a given center, thus maintaining an equa distance; the rove is taken hold of by a movable arm in connection therewith, and pushed against the end of another movable arm, (part of the same combination,) which holds the rove for a moment until a

further movement of the two wheels brings two other arms in contact in the same manner; meanwhile, the former arms relax their hold of the rove, and the twist upon the forward portion of the yarn in an instant communicates a small portion of its twist to that which is behind, just sufficient to give the rove strength to hold together as it proceeds onward to be fully twisted. Judging by the mode of treatment as seen at work, it did not appear to act so gently with softly-twisted yarn as does the mule, and most probably it will yet be found limited in its application, except to the stronger sorts of yarn that will submit to the rougher handling which seems inherent in Mr. Avery's continuous wool-spinner; but whatever may be the case, it was impossible not to admire some of the devices that have been introduced to perform such a delicate operation, and it is to be hoped that it will fully realize the inventor's expectations.

98. For some considerable time past, America has been great in boot and shoe making by machinery. While many causes have operated in producing this result, the scarcity of labor and the aptitude of the American machinists for the invention of such labor-saving devices, have been the chief propelling influences to lead to their present proficiency. A most interesting collection of machinery, having for its object the heeling of boots and shoes, was exhibited in operation, and attracted special attention from the people of all nations, not only on account of the novelty, but likewise from the perfect manner in which it performed its work. This plant of machinery was exhibited by Horace H. Bigelow, of Worcester, Mass. The principal machines were of three classes: The first machine was for compressing the leather in order to render it hard and firm, but it was done partly from the exterior edges, in order to prevent the waste by trimming off, as is customary with shoemakers; it thus made the leather thicker by the quantity of leather that was in the odd corners. The character of the compressing-machine will be approximately understood by its being stated that it resembles a slotting-machine with a screw arrangement to accommodate the increasing thickness of the heel, as piece after piece is introduced into the die. Before the pieces are put into the die, however, they are first compressed upon the edge by being subjected to the action of a movable horizontal jaw or mold that is actuated by means of a toggle-joint, thus bringing them roughly into form for the machine. The great pressure, combined with the polished condition of the die, has the effect of giving a fine polished appearance to the entire exterior of the heel. While in the die, an instrument charged with awls pierces through the mass, the requisite nails are inserted into the respective holes, and thus it is made ready for the second or attaching machine, which is adapted to receive the boot or shoe; and by the pressure of the machine, with accumulated power from suitable gearing combined with a fly-wheel, the heel is firmly attached in an instant. The article then passes to a third machine containing a revolving cylin-

der, with an emery surface at each end, against which the lower part of the heel is pressed, in order to polish off the nails and leather, the dust disengaged being carried away by means of a fan within the cylinder. In addition to the foregoing, there were a number of contrivances for cutting out soles and heels, and for other operations in connection with the crispin art. The Americans are manufacturing boots and shoes by the aid of these machines, with Chinese labor, and they state that the compresser-machine turns out 1,200 pairs per day, and that the attaching-machine, with two boys, produces 60 pairs per hour; but whatever may be the quantity of work performed, the machines certainly execute the work with great rapidity, and the quality apparently equal to the best hand-work. It may seem a hardship to the shoemaker to introduce machines to supersede his labor, but it is not so in the end. The old trades, by the competition of past ages, are ground so low that it is rendered desirable to introduce new systems of working, if only to give the operatives a fresh start, because such machines, by their increased production with a given quantity of labor, will really enable higher wages to be paid without increasing the price to the purchaser; but it may, at the same time, prove a misfortune to those individuals who have not the natural aptitude to fall readily into new methods of working.

99. One of the most conspicuous novelties, which excited general admiration, was the Woodbury brush-making machine, exhibited by H. C. Covert, of New York. The object of the machine was to insert the packets of bristles into suitable holes pierced in the solid wood; a bundle of bristles was given to the machine, which carefully assorted them into packets; these were each bound and entwined with a fine brass wire, which is cut to length; the hole in the wood was drilled and tapped to form a screw, and the wire-binding became the corresponding thread, which the machine inserted and screwed home; but the most ingenious part of the contrivance was in connection with the wire-binding, which was so arranged that any attempt to unscrew the binding-wire caused it to slacken, and open by the effort, and thereby catch a firmer grip into the hole formed in the wood. This machine was entirely self-acting, and performed its work rapidly, faster than the eye could follow, and the various steps could only be seen by moving the machine slowly. This interesting tool is likely to make its way in the world; it well deserves the attention of brush-makers, and it is certain to find its way into England, because the brushes so made are superior to those made by the usual methods.

100. As might be expected, America was well represented in sewing-machines by all the leading houses, including Howe, the inventor, and these machines, as a rule, were not surpassed by those from any other country. One in particular, the "Weed sewing-machine," is so contrived that the action of the needle can be stopped without incurring the trouble of stopping the general motion, including the treadle. An

ingenious machine was shown for splitting leather, entirely novel in its action.

101. In apparatus for making soda and mineral waters, the Americans were the first at Vienna. The display made by Mr. John Matthews, of New York, of machinery for this purpose, was a marvel of ingenuity, and the several constructions were splendid in the strictest sense of the word, both in regard to magnitude and polish, every part being beautifully silvered on the surface.

102. The above-mentioned machines are only a few of the more prominent novelties in the American department, for it was full of riches in other respects, and especially in what may be considered the trifles of workshop appliances, ingenious chucks, friction-clutches, modes of holding articles, and other things too numerous to mention in this brief report. It also contained some things which were not so good, and even some of bad design and hasty workmanship. That, however, is of no useful interest to us, and it is a remarkable feature with the Americans that their defects at one exhibition are generally eliminated before the next takes place.

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In conclusion, it may be asked what is the great lesson taught to ourselves by the Vienna Exhibition? It shows us clearly and certainly that in regard to the classes of articles which are referred to in this report, we have henceforth no monopoly in them, and that our success in the future will entirely depend upon the united co-operation of capital with both thinkers and workers, with each in his own place doing his utmost to refine and improve our productions, and in the devising of better auxiliary means in order to produce them more and more rapidly and economically. If, therefore, we are wise, and earnestly resolve to do so as a united people, then we may still be enabled to secure our fair share of the material advantages which are to be derived therefrom; but if, on the other hand, we are disposed to rest upon our oars as thinkers, and if at the same time our workmen do not see that it is their duty and to their self-interest to aid heartily in the cheapening of production, we may rest assured that other nations, which may be wiser in their generation, and therefore act more sensibly, will gradually step in before us, and reap the harvest which was sown by our fathers, and that the rich inheritance bequeathed to us will slip through our fingers inperceptibly but certainly, and most probably forever. It is for us to choose now, for if we wait until the brink of the precipice is in view, it will then be too late.

The changes that overtake nations are due to the effect of natural causes, previously existing and acting on the minds of society generally, and are as definite in their ultimate result as the ordinary laws of nature. There are well-authenticated instances of trade having shifted its locality in direct consequence of the unwise conduct of individuals who were not acquainted with the principles of political economy. It is,

therefore, most desirable that every boy, before leaving school, should be well grounded in some of the elements of that branch of knowledge in order to keep us right, as a nation, in regard to the vital questions that are involved in the solution of the problem here referred to, and on which the permanence of our machinery trade necessarily depends.

We likewise require a larger diffusion of high-class, scientific education, in combination with thorough training in the technological branches of knowledge that bear on each several specialty, not only for workmen, but more especially for foremen, draughtsmen, and managers, and still more so for masters; nothing less will place us upon an equality with the rising young men of Germany.

This, therefore, is a serious matter, requiring the immediate attention and deep consideration of all who take interest in the future welfare of Great Britain.

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STEAM AND HYDRAULIC MACHINERY.

Report of Mr. G. C. V. Holmes.

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103. America.—For reasons which need not be here inquired into, the American section was by no means so complete a success as it might have been, and hence it came to pass that the country which has hitherto always been foremost in steam-engine reform was not so conspicuous at Vienna.

There were only four stationary engines exhibited, one of which, from the Norwalk Iron Works, was employed in driving the greater part of the shafting of the department. This was a simple horizontal non-condensing engine, with Corliss framing, but nothing remarkable or instructive about it in any way. The New York Safety Steam-Power Company showed two small vertical engines.

104. The fourth and most remarkable was sent in by Messrs. Pickering & Davis, of Portland, Conn. This was a single cylinder, horizontal, direct-acting, non-condensing engine, its chief peculiarity being the absence of any bed-plate or framing connecting the cylinder with the plummer-blocks. There are two connecting-rods, the cranks being outside the two plummer-blocks, and the fly-wheel revolves between them. The space here is necessarily limited, so that the rim of the fly-wheel has not the width necessary for the ordinary flat belting. To remedy this defect, the rim has a deep V-shaped groove cut in it, and the belt is also V-shaped, being formed of several thicknesses of leather riveted together so as to fit into the groove. A belt, however, of the thickness which this implies, would be too stiff to revolve, and consequently the V section has to be notched transversely at intervals of two or three inches all along the belt, in order to give it the necessary pliability. This system has been found to possess many good qualities. Another peculi-

arity about the engine is, that the piston-rod and valve-spindle are formed of cold-rolled iron which has never been in the lathe.

105. The shafting in the American department was formed of this material, and very superior qualities of strength, toughness, and rigidity are claimed for it, in addition to the advantage that on leaving the rolls it is finished and never requires turning. In the American department too much advantage was taken of these qualities, for the section of the shafting was so reduced, in order, we suppose, to show off the good points of the material, that considerable uneasiness was caused by the manner in which it whipped whenever there was even a moderately heavy amount of work to be done. The sole manufacturers are Messrs. Jones & Laughlins, of Pittsburgh.

106. There are only two steam-pumps shown in this part of the hall, one of which is on Earle's well-known patent, and is exhibited by the Norwalk Iron Works; it will be referred to in greater detail hereafter, when describing the pumping-engines shown by Messrs. Decker, of Canstatt, who are Mr. Earle's sole licensees on the continent.

America exhibits only one hydraulic motor, viz: a turbine by the Capron Water-Wheel Manufacturing Company, Hudson, N. Y., and also but one steam-boiler, by Pitkin Brothers, of Hartford, Conn.

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AGRICULTURAL MACHINERY.

Report of Colonel Michael.

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107. The Americans have for some years past had a large share of the supply of reaping-machines to Austria and Hungary and parts of Russia, and it is, therefore, not surprising that the exhibits of agricultural machinery from the United States should be confined in a great measure to reapers and mowers, a large proportion being combined machines. The American machines are so well known in the agricultural world that it will be sufficient, perhaps, to say that their more remarkable characteristics are lightness, which adapts them to the power of small-sized horses, their elegance of appearance, as compared with those of other nations, and their comfortable seats provided for the driver, whose weight is made to balance the whole machine, and who has all the gear connected with regulating the rakes, cutters, &c., immediately at his hand.

108. The American recipient of a diploma of honor was Mr. Walter A. Wood, of Hoosick Falls, N. Y., whose "new champion" reaping and mowing machines are all but perfect. He also exhibited a reaper with a chain-rake, which it is said has found favor in the United States, but which was not very highly approved by the jury, inasmuch as it has the obvious fault of affording no means for insuring regularity in the size of the sheaf where the crop is unequally grown. Mr. Wood

also exhibited the machine referred to in the preceding page, in which the sheaf is bound with wire as it is reaped.

The reaper and binder has only very lately been completed, after three years' working out of the idea, and at a large outlay of money. Mr. Wood stated to the jury that he has good accounts of the few machines that have been put out to work this year in America, and, in the event of acknowledged success, he expects that the demand for them will be as great as that which existed for automatic raking-machines when they first began to supersede those which required a hand-rake delivery.

The reaper and binder has an endless apron, upon which the cut grain falls, and which carries it to the outer side of the reaper and deposits it in a trough, where the sheaf is bound with wire, and is then tossed clear of the machine by one of the revolving arms which helps to bind it.

The binding operation is very ingenious and effective, as was demonstrated to the jury by means of a bundle of loose newspapers. Two iron arms, which swing from the same center, but in opposite directions, compress the bundle of grain, as would a man's arms, and form a sheaf; the wire is drawn from a reel held by a spring just taut enough to keep it straight, and is passed around the sheaf by one of the revolving arms, at the end of which is a steel twisting-gear, which meshes into a rack under the trough, where the wire is twisted and cut off. The arms are started and stopped by a very simple contrivance, which enables the man in charge to regulate the size of his sheaf.

109. Messrs. Aultmann, Miller & Co.'s reaper, fitted with a revolving-table rake, was a novelty of which the jury saw no reason to approve. The "Johnston" rakes, of which there are many varieties, do their work so well, and are so capable of being regulated in their working as to insure uniformity in the size of the sheaf, that neither chain nor revolving-table rakes appear likely to supersede them.

The American trade in agricultural implements with Australia has very much declined of late years, owing to non-residents in the colonies being unable to protect themselves by patents. It is said, however, that out of about 100,000 reapers and mowers constructed annually in the United States, about 12,000 find their way to Great Britain and the continent.

110. The question as to whether a benefit, or the reverse, is conferred on the agriculturist generally by the construction of the combined reaping and mowing machines, was frequently a matter of discussion among the jury. Some were in their favor, but others were of opinion that the benefit is exceptional and confined to the very small farmer. It was argued that a well-to-do man would probably do better if he were to invest his capital in the first instance in two machines, a reaper and a mower, both of which would always be available for use, and would never be subjected to the trying operation of changing at unmechanical hands. He would thus get the full number of years' work out of both

implements; but from motives of economy he is tempted to buy a combined machine at two-thirds of the cost, and he finds that he not only incurs delay in cutting crops which he could get in if he possessed two implements, but he has always the risk of damage and expense for repairs consequent on the frequent changes necessary to his single combined machine.

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SMALL-ARMS.

Report of Mr. W. H. Russell.

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111. The exhibitors from the United States, although they wished to subject their cases to the judgment of this jury, came more properly under the consideration of the jury which dealt with arms of war. They were Mr. Remington, Mr. Sharp, Messrs. Smith & Wesson, Mr. Colt.

112. The merits of Mr. Remington's system are well known, but I should not have mentioned his exhibits here had it not been necessary to call attention to his single-barreled rifles adapted for sporting purposes, in which, by recent improvements, a direct action is obtained in the lock-apparatus, and the pin is withdrawn by the action of loading, and is no longer liable to damage by rust. These weapons, and also revolvers on his principle, were well finished and cheap. (Honorable Mention.)

113. Sharp has introduced no improvement in his well-known arm. The rifles he exhibited were very heavy, and not as well finished as those of Remington, but his system is essentially safe, and it is impossible to discharge the rifle till the loading-movement has been completed.

114. Smith & Wesson's arms could not be examined by the jury, as they were attached to the shield on which they were exhibited, but those which could be taken down seemed well finished, though the locks were not all equal in that respect, and the back-sights on the rifles were placed badly and would apparently interfere with the loading of the arm.

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MINERAL FUEL.

Reports of W. H. Maw and James Dredge.

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115. Looking now at America, the last continent in our review of mineral fuel, we find the Pacific coast very deficient in coals. The extensive coal formation of Vancouver Island is of Tertiary age, and, stretching from Georgia Bay as far as the island of Saturra, contains two seams of ordinary brown coal and pitch-coal of very good quality, 6 to 8 feet thick; the coal is worked at several places for steam purposes with considerable advantage. In Washington Territory, opposite Vancouver Island, an extensive Tertiary basin is found, near Bellingham Bay. It is composed of sandstone, and contains ten seams of bitumin-

ous glance coal, with an aggregate thickness of 116 feet. The coal gives a very good coke, and is fit for the use of blast-furnaces. Tertiary coals are also found in California, at Santa Clara and Goose Bay, where three seams, one 9 feet thick, cover a great surface, and contain a good glance coal, with only 3 to 4 per cent. of ash; similar coal-beds are found 23 miles south of Cape Flattery, and beds of lignite at Port Oxford and Astoria. Coals of Cretacean age have also been discovered in the Sierra Nevada. In San Salvador, in Central America, a large seam of pitch-coal is known to exist near the meeting of the rivers Fitigupa and Lempa, and on the Isthmus of Panama, near Cultivation Creek and Blands River, an Eocene formation contains six seams of excellent black bituminous glance coal, 30 feet thick. On the west coast of South America, mineral fuel is only known in Chili at Lota, near Valparaiso. Here a bed of black pitch-coal is found, as is the case near Concepcion and Calcurra Bay, south of Valparaiso. The coals yield here over 70 per cent. of carbon, with 5 to 7 per cent. of ashes. Besides these Tertiary coals, others of Liassic age seem to exist at St. Jago and Aconcagua, in Chili.

In Brazil several coal-basins are known, though none of them have as yet reached great importance. In the province of Rio Grande do Sul, west of Port Allegre, three coal-fields are explored. The greatest is that of Candiota, covering an area of one hundred and fifty square miles. In the mines of the Rio Grande Coal Company several seams, with 65 feet of good bituminous coal (which, according to the researches of Professor Agassiz, belong to the real Carboniferous period) are worked with great advantage, the thickest seam being 25 feet. A second basin is that of Rio Ratos, with fifty square miles; the coal specimens shown from it by Dr. Ubatuba much resemble English Newcastle coal, as do the coals of the third basin of Rio Tubaras, or Passa-dous, in Santa Catharina, exhibited by Viscount Barbacena. All these basins promise to become of the utmost value for the development of Brazilian industry. The United States of Venezuela likewise made a good show at Vienna with their specimens of coal, which are almost all derived from the Eocene formation at Curamichate, near Coro, west of Caraccas, and at Piaco and Barcelona. The coal is glance coal, and part of it is suited for coke; other beds are composed of lignite. The formation also contains anthracite coal, near La Guayra, samples of which were exhibited by Mr. Stelling. Lastly, in Colombia an extensive Eocene coal formation exists at Chirigui, in the province of Veragua. Here six beds of coal, 73 feet thick, and containing black-glance coal, with 6 per cent. of ashes, extend over a belt fifty miles long and five to fourteen miles broad, between the Rio Changuinola and Cape Valienti. The best coal is found at the mouth of the Changuinola, where it is bituminous, while on other places it becomes anthracitic or lignitic.

116. We conclude our sketch of the mineral-fuel exhibits at Vienna with the United States of America. As is well known, North America

is one of the richest coal-countries in the world. Her coal-fields, west of the Alleghany Mountains, extend over the greater part of Pennsylvania, Ohio, Maryland, West Virginia, Kentucky, Tennessee, Alabama, and Georgia, covering an area of more than 55,000 square miles of bituminous coal. The development of the North American coal industry has made rapid strides, and the annual production of coal has increased from 21,000,000 tons, in 1866, to 34,000,000 tons in 1871, and to 41,752,000 tons in 1872. The quality of the coal is very good, and about one-half of the out-put consists of anthracite and the other half of bituminous coal, which makes excellent coke. The latter is principally raised in Pennsylvania and Ohio, where the great bituminous-coal bed stretches from Pittsburgh as far as west of the Ohio—its northern outcrop being five miles from Pittsburgh, its southern near Beaver. It is composed of three layers, the main-breast coal 5 feet to 6 feet thick, a stratum of shale, and again of coal. The anthracite region, however, composes the eastern portion of the great Carboniferous formation, and in Pennsylvania alone it covers 297,000 acres, containing, in the counties of Schuylkill, 108 feet; Lehigh, 50 feet; Shamokin, 70 feet; Lackawanna, 60 feet; and Wyoming 100 feet of anthracite coal. The most important is the Schuylkill district, where the mammoth seam contains from 20 feet to 60 feet of coal. The quality is generally very good, Pennsylvania anthracite containing 85 to 90 per cent. of carbon, and 1 to 5 per cent. of ashes; Pennsylvania and Maryland steam-coal 71 to 77 of carbon, and 6 to 9 of ash; and bituminous coal 62 to 65 of carbon, 26 to 35 of gaseous substances, and 2 to 9 per cent. of ash. The best steam-coal comes from Cumberland, in Maryland. Exhibits of American coals and coke were shown at Vienna, from Pennsylvania, by Amasa McCoy and Philo Norton, and by the Dunbar Iron Company; from Ohio by the Cincinnati, Rockport and Southwestern Railway; and from Alabama, by R. Rothwell. Coals from Indiana were exhibited by the State geologist, Mr. E. D. Cox, of Indianapolis, and by the Otter Creek Black Coal Company; these coals being anthracitic, but used in blast and puddling furnaces. Professor Guido Kustel showed black coal, most likely of more recent age, from Weber River, in Utah. The United States own also enormous masses of Tertiary coals, a broad belt of such deposits stretching east of the Rocky Mountains, from north to south, through the States of Montana, Dakota, Wyoming, Nebraska, Colorado, Kansas, Indiana, and Texas, as far as the Gulf of Mexico. The mineral treasures which are heaped up here are as yet very imperfectly known, and it will be reserved for future times to make the best use of them.

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LOCOMOTIVES.

Report of W. H. Maw and James Dredge.

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117. In concluding the present report, it appears to us desirable that we should, to a greater or less extent, summarize the facts which

were to be learned from a study of the great variety of locomotives collected at the late Vienna Exhibition. That many hints were to be derived from such a study, few English engineers, who had an opportunity of visiting the Exhibition personally, will feel disposed to deny, and it has been our object in this report to afford, as far as is possible by the publication of full illustrations and descriptions, the same opportunities for study to those of our readers who were unable to visit Vienna. It will, we think, be generally acknowledged that as far as materials and workmanship go, the locomotives turned out by the leading German builders are fully equal to those of our own makers, although it is probable that if the average workmanship of the whole of the German locomotive manufacturers was compared with the average productions of the whole of the English firms, the result would be in favor of the latter. In other words, we believe that there is a greater proportion of thoroughly first-class work turned out here than in Germany. However that may be, it is certain that the engines produced by Borsig, Schwartzkopff, Hartmann, and a few other German makers will hold their own, as far as workmanship and materials are concerned, with any made here, and it is no use closing our eyes to the fact.

To the French, Belgian, and Austrian makers we cannot award such a high place, for although in each of these countries, and particularly in Belgium, numbers of thoroughly well-built locomotives are turned out, the general average of the workmanship is decidedly below that of Germany. In French engines especially we have noticed some wonderful specimens of fitting, particularly where frame-stays and similar parts are concerned, while as regards the finish of the cleading, the flatness of the hand-rail plates, splasher-plates, &c., and the numerous small points of finish which characterize the work of our leading English firms, the French makers are wofully deficient. It is true that the large goods-engine exhibited at Vienna by Messrs. Schneider & Co. was finished in the highest possible way, thus proving the capabilities of that vast establishment; but in making these remarks about workmanship we are not thinking so much of the exhibited engines as of the locomotives we have, from time to time, had the opportunity of examining on various continental railways. As far as materials are concerned, our makers can now, we think, scarcely be considered as possessing any particular advantage—except in some cases as regards price—over their continental rivals.

If, however—leaving materials and workmanship—we turn to the matter of design, we shall find many points requiring discussion. There are, no doubt, certain special features of the continental traffic, such as its very heavy character on some lines and the lower speed at which it is generally carried on, which have led naturally to special features in the locomotives employed to work it; but, apart from these exceptional matters, there are important differences in the construction of the locomotives employed in working-traffic almost identical with that to be accommodated here, which are somewhat difficult to explain.

In the first place, speaking broadly, the inside-cylinder locomotive may be said to have died out on the continent. Such engines are still occasionally built, it is true, but we have traveled for days on continental railways without seeing a single specimen, while out of the whole forty-seven locomotives exhibited at Vienna there was but one with inside cylinders, namely, an Engerth engine, belonging to the Austrian State Railway Company. In this country, on the contrary, a large proportion of the engines in use have always been of the inside-cylinder type, while at the present time such engines are in special favor on a number of our principal lines, the introduction of steel as a material for crank-axles and the employment of inside frames only having practically done away with the great source of trouble in former days. We have no intention of entering here into the vexed question of inside *versus* outside cylinders, but we desire to direct attention to the broad difference in this respect between English and continental practice. Regarding the reason for this difference, it is somewhat difficult to arrive at a satisfactory conclusion; but to some extent, at least, it appears to have arisen from the demand on many continental lines for engines of exceptionally great power. It is undeniable that when very small-wheeled engines with large cylinder-power have to be constructed, the retention of the inside-cylinder type leads to many difficulties and disadvantages, and hence such engines have been almost universally constructed on the continent with outside cylinders, and, in a large proportion of cases, with outside valve-gear also. It having been found that at the moderate speeds at which such engines are run the arrangement involved no ill effects, a similar design has been largely introduced for classes of engines where there was really no such good reason for its adoption. To a large extent, also, the employment of outside valve-gear on the continent is due to Mr. T. R. Crampton. Of the well-known Crampton engine there are still large numbers at work doing passenger-service on the Northern Railway of France and other French lines, and the influence of these engines on locomotive design can be traced in many ways, not only in France and Belgium but also in Germany. Another English locomotive-engineer whose plans have largely affected locomotive-construction on the continent is Mr. Joseph Hall, now and for many years past settled at Graz, whose system of engines with outside cylinders and outside frames has obtained a strong hold, particularly in Austria and Southern Germany. Such are some of the influences which have been brought to bear upon continental locomotive-design, while it may be added that the employment of external working-gear has, no doubt, been, to some extent, fostered by the fact that the construction of continental stations, &c., permits of a width of locomotive which it would be utterly impossible to employ on English lines.

We have above referred incidentally to the influence of the nature of continental traffic on the design of goods-locomotives, and it may be well that we should discuss some of the features of these engines at

greater length. The extremely heavy character of the goods-traffic to be carried on some of the leading continental railways, and particularly on some of the mountain lines more recently constructed, has in fact called into existence several types of powerful locomotives differing materially from any in use in this country. The Vienna Exhibition contained many examples of such types, illustrating the chief modes in which the continental locomotive-engineers have endeavored to solve the problem before them, namely, how best to produce locomotives of exceptionally great tractive power. Our present object is to speak of some of these plans, and to compare them with other modes of attaining the same ends.

In the majority of cases the locomotives built for exceptionally heavy work on the continent are eight-wheeled, all wheels being coupled, and all axles being under the barrel of the boiler. The cylinders are outside, and in a large number of instances the engines are built upon Hall's system, and have outside frames and outside cranks. The wheel-base is kept as short as possible, and flexibility is given by allowing lateral play to the trailing, or, in some cases, both leading and trailing, axles. Such, in broad terms, are the leading characteristics of the exceptionally heavy-goods engines now made on the continent, and it is undeniable that such engines do a large amount of work at slow speeds in a fairly satisfactory way. Notwithstanding this, however, it is, we think, equally undeniable that they possess many grave defects which may be avoided by adopting another system of construction.

In the first place, the necessity which exists for maintaining a short wheel-base has led to the practice of putting all the axles under the barrel of the boiler, the result being an excessive length of boiler-barrels and of tubes—tubes 15 feet and 15 feet 6 inches long being common, while, in some cases, the length reaches 16 feet 6 inches. To make the engines ride more easily, also, compensating beams are generally being introduced between the driving and trailing springs, and not unfrequently between the springs of the leading and second wheels also, and these compensating beams, although undoubtedly useful for reducing shocks, tend in some cases to reduce the control of the longitudinal oscillations or pitching motion to which the excessive overhang of the engines gives rise. Considering that the normal load on a pair of wheels in one of these heavy engines is generally between 12 and 13 tons, it is evident that the oscillations and augmentations of this load, due to insufficiently controlled pitching-motion, must have a most serious effect upon the road, and most materially increase the cost of maintenance of the latter.

118. The true remedy for this state of things is, undoubtedly, the adoption of the double-bogie system. Once let that system be adopted, and we get rid of all difficulties such as those to which we have just alluded. We can lengthen the wheel-base of the engine to any desired extent, so as to obtain longitudinal steadiness, while, at the same time,

we retain the utmost facility for traversing sharp curves, and especially we get rid of those variations of load per wheel due to pitching, which, in engines with great overhang, play such havoc with the permanent way. In a double-bogie engine the weight of all parts above the bogie is transmitted to the bogie-pins, and is distributed over the wheels of the bogies in the proportions determined by the positions of those pins, the distribution thus effected being practically constant under all circumstances, and being only modified to an immaterial extent by the motion of the reciprocating parts of the working-gear. The advantages of this state of affairs are even greater than may at first appear. If the construction of an engine is such that the normal load per axle is liable to be sometimes increased by the pitching action to the extent of thirty or forty per cent., then in fixing the normal load this circumstance must be allowed for, and the load made less than it might be if its constancy could be insured. The double-bogie system, as we have seen, gives this constancy, and hence it follows that in an engine constructed on that system a greater load may be carried upon each pair of wheels than would be safe under other circumstances. On the other hand, also, the double-bogie system gives every facility for decreasing the load per wheel, if desired. Practically, it is found undesirable to couple more than four pairs of wheels; but if we divide our power between two groups, each with its own pair of cylinders, we at once double our power of distributing the load, and can, if necessary, divide that load between sixteen wheels instead of eight, without incurring difficulties. Taking into account the constancy of the distribution of the load already alluded to, however, we are inclined to believe that it will be on but very rare occasions necessary to resort to eight-coupled bogies, a maximum of six wheels per bogie, or twelve in all, being, we think, all that is likely to be required even for mountain locomotives, at all events for many years to come.

Another advantage of the double-bogie system attendant upon the features which we have just pointed out is, that it enables us to produce tank-engines for the very heaviest classes of work, and capable of carrying large supplies of water and fuel. The eight-coupled type of engine, so much favored on the continent, is quite unadapted for transformation into a tank-engine, as the load per wheel in those engines is already as great as it is safe to carry under such conditions; hence, these engines are made generally with a light class of tender, the weight of which, however, is always, and necessarily so, greater than that of the tanks and coal-bunkers required to make the double-bogie engine carry its own fuel and water. As every ton saved in the weight of an engine, or of an engine and tender combined, if a tender is used, without decreasing its efficiency, means so much added to the useful load it is capable of hauling, the importance of this is evident.

It has been urged in some quarters that it is a mistake to carry the fuel and water on engines intended for heavy work on inclines, as the

weight available for adhesion becomes reduced as the incline is mounted. The fallacy of such an argument is almost self-evident; but as the objection has been seriously advanced, it may be worth while to say a few words respecting it. It will, we think, be conceded that for very low speeds, such as are resorted to on heavy gradients, engines may be constructed in which the hauling-power is limited only by the adhesion available. In other words, the boiler and cylinder power may at these low speeds always be in excess of the adhesion. This being so, it is desirable to turn to account, for increasing the adhesion, the weights of all necessary parts of the engine, among which the tanks and fuel-bunkers must evidently be counted. If these parts be mounted on separate wheels, and thus formed into a tender, they simply increase the load to be drawn, and reduce by so much the weight of train which the engine is capable of hauling. If, on the other hand, they are carried on the engine itself, they increase its hauling power to the extent due to their own weight, and this, whether they are full or empty.

There is another point in which the double-bogie system offers an important advantage, and that is in the facility it affords for the construction of very powerful boilers carrying high pressure of steam. An examination of the large goods-locomotives now being constructed on the continent will show that the limits of steam-generating power afforded by the ordinary locomotive-boiler have practically been reached. Already there are running boilers 5 feet in diameter—a diameter which is nearly as great as can well be accommodated, while it is one which necessitates the use of very thick plates, or else a reduction of the pressure below that with which the best results are being obtained in this country. It is quite true that 5-foot boilers may be made to stand far higher pressure than those at which they are now worked, while, of course, if necessary, ⅞-inch or 1-inch plates could be employed in their construction, just as they are in modern marine boilers. But in the case of locomotive-boilers, the use of such plates would lead to many difficulties, and we think few locomotive-superintendents would care to adopt them. If, now, the double-bogie system could be carried out in its integrity, as is done by Mr. Fairlie, the engines being built with a double boiler and central fire-box, we at once get rid of all difficulties about boiler-power. It is evident, in fact, that this system gives us the means of producing boilers twice as powerful as any ordinary boilers now in use, without increasing the thickness of plates; or, on the other hand, if the present power be retained, it enables us to reduce the diameter of boiler-barrel, and to employ plates of a more manageable thickness. It also, as will be readily understood, gives us the advantage of a constant depth of water over the fire-box crown, whether the engine is on a level or on a gradient, while it likewise enables us to increase the fire-grate area to any desirable extent, without producing the evils due to overhang.

119. We have already alluded to the excessive length of tubes em

ployed on many continental goods-engines, and we have pointed out that this is due to the packing of all the wheels under the barrel of the boiler. We have known it urged that this great length of tube is necessitated by the nature of the fuel consumed on many continental lines, the long tubes being required to obtain a reasonably good evaporative duty from the inferior class of coal available. In other words, it has been stated that the length of the tubes is not a result of the position of the axles, but that the position of the axles has resulted from the necessity for long tubes. This argument is, however, directly negatived by the practice of the engineers by whom these long-tubed engines are built, for on the very lines on which eight-coupled engines with tubes 15 feet 6 inches to over 16 feet long are at work, we find also in use six-coupled and passenger engines with tubes of the same diameter, but 2 feet to 3 feet shorter. As all these engines are using the same fuel, and as longer tubes could certainly be used in the two latter classes of engines, if it was specially desirable, the natural deduction is that the tubes are shortened when circumstances permit of this being done. With the double boiler, the tubes can of course be kept with the ordinary proportions of length to diameter. The subject of locomotive-boiler proportions for different classes of work and varieties of fuel is, however, one on which much could be said, but it is not one into which we can enter here.

We have brought forward the above facts because we see on all hands an increase in the class of railways on which, of all others, the double-bogie system can be employed with advantageous results. Everywhere there is a tendency to build lines of moderate first cost, this desire to economize on the original outlay leading to the adoption of steeper gradients, sharper curves, and a narrower gauge, besides, in many cases, a lighter type of permanent way. By the adoption of Fairlie engines, such lines can be made to accommodate an amount of traffic, which is out of the question so long as ordinary locomotives are used, unless, indeed, the latter be employed to a great disadvantage. On mountain lines of more costly construction, or on other railways having to accommodate a very heavy goods-traffic, the adoption of the double-bogie system would not only enable an increase to be made in the loads drawn, but would effect a most material reduction in the cost of permanent-way maintenance, a matter which is but too often neglected by those having to provide locomotive-power. The Fairlie system is no longer an experiment, but an established fact, and it behoves all in charge of such lines as we have mentioned to learn for themselves the lessons which it teaches on the railways where it is in use.

In the above remarks we have referred especially to the heavier class of goods-engines employed on lines having sharp curves; but we may add that in many instances on the continent six-coupled engines with exceedingly short wheel-bases are used where there are really no sharp curves to be traversed. In such instances our modern type of six-

coupled locomotives with inside frames, inside cylinders, and valve-gear, and with the trailing axle either below or behind the fire-box, might, we are convinced, be introduced with material advantage, especially to the permanent way. In fact, we consider that it is only the slow speed at which the goods-traffic is worked which allows the present type of continental engines, with their great overhang, to be tolerated. The adoption of the Hall system, too, for six and eight coupled engines we cannot regard with favor, believing, as we do, that it is a system which for such engines must always give rise to heavy charges for maintenance, owing, among other things, to the fracture of the outside cranks.

120. As regards the passenger-engines, the remarks we have made above also apply to some, although not to so great an extent. There are at work on many continental lines numbers of passenger-engines the short wheel-base of which, combined with their great overhang laterally, would cause them to be regarded with small favor in this country; but while this is the case, there are, on the other hand, a vast number of engines of excellent design, and of types varying but little from those regarded here as representing the best practice. Engines with a single pair of drivers are very rarely to be met with on the continent, except on those French lines where the Crampton pattern is adhered to; but Hartmann, Koechlin, and others in Germany, as well as some of the Belgian makers, have produced some very good patterns of outside-cylinder engines, with driving and trailing wheels coupled, which are doing good service. In a number of instances these engines have outside gears—in Belgium the Walschaert gear being largely used—but although this arrangement gives great accessibility, we think that the balance of advantages is decidedly in favor of placing the gear inside the frames. Many continental passenger-engines, too, are constructed on the Hall system; but, as we have pointed out in our descriptions of engines exhibited at Vienna, the adoption of this system involves the use of a greater weight of material in the construction of an engine of a given power than if the inside-frame pattern be used, while it is also attended with other disadvantages which render it difficult to understand the favor with which it is regarded by its advocates. One point in its favor undoubtedly is that it affords facilities for using an increased width of fire-box; but in the case of ordinary passenger-engines the requisite size of fire-box can be got in between the ordinary inside frame, so that this advantage ceases to be of importance.

We have had occasion to allude in the course of the foregoing report to the large diameter of coupled leading-wheels employed on some continental locomotives. In this country there is a prejudice—and to a great extent a well-founded one—against the running of such large wheels as leaders; but it must, nevertheless, be remembered that many tank-engines, with coupled driving and trailing wheels of large diameter, are habitually run trailing-end first at speeds quite as high as those at which the continental engines just referred to are worked. We

mention this, not to justify the practice of using very large coupled leading-wheels, for we believe that the use of such wheels is attended with a certain amount of extra danger, but to show that the objections sometimes raised to them are to some extent contradicted by the practice of the objectors.

The application of bogies to either tank or tender engines has not as yet obtained any great hold on the continent generally, although many bogie-engines are running in Austria and Russia. For the most part these engines are fitted with the old-fashioned center-pin bogie, although the Bissell truck has also made its way to a small extent. The Adams bogie, which we regard as the best type yet brought out here, has not, so far as we are aware, been introduced on the continent; at all events, we have never met with it there. It is, we think, much to be regretted that this bogie was not represented at the Vienna Exhibition.

As regards details, we need say little here, as we have expressed our opinions pretty fully in describing the various engines exhibited. We may, however, allude to the excessive thickness of boiler-plates, and especially of copper plates for inside fire-boxes, almost universally adopted on the continent—thicknesses which lead to disadvantageous dead-weight, and which, if good material be used, are absolutely unnecessary, as the experience in this country proves. In the case of copper fire-boxes, too, the extra thickness is, we consider, a positive disadvantage in every way, leading, as it does, to a more rapid wear under the action of the fire, as shown by the short lives of the copper fire-boxes on some of the Austrian lines. The large domes generally applied to the boilers of continental locomotives do good service, and, although on æsthetical grounds they may be objected to, we believe that they might in many cases be used here with much advantage. As regards the working-gear, there is but one fact to which we desire to allude here, and that is that the solid-bushed coupling-rod ends, now so largely used in this country, seem, as yet, to have found no favor on the continent. There was at the Vienna Exhibition but one locomotive having solid unadjustable bushes at the ends of the coupling-rods, and even in this case the bushes were not fitted in the simple way usual here. The advantages afforded by the use of these bushes is such, however, that their adoption on the continent as extensively as here can scarcely be much longer delayed.

We have now completed our brief survey of some of the leading features of continental locomotives as illustrated by the Vienna exhibits, and in bringing this report to a conclusion we can but again express our regret that English makers should have been so inadequately represented at Vienna, and that no opportunity was afforded of comparing our own and continental practice with that of our friends on the other side of the Atlantic.

HORIZONTAL ENGINES WITH SLIDE-VALVES.—UNITED STATES.

Report of W. H. Maw and James Dredge.

121. Commencing at the western end of the Machinery Hall, we found in the United States section one engine coming under the present class. This engine, which drove a portion of the machinery of its section, was one which attracted considerable attention on account of the novel features embraced in its construction. It was constructed on the plans of Mr. Pickering, of the firm of Pickering & Davis, of Portland, Connecticut, United States, an engineer well known in this country from his neat steam-engine governor, and in designing it, one of the chief points kept in view was to do away with the bed-plate and to resist the strains due to the action of the steam on the piston by a direct connection between the cylinder and the crank-shaft bearings. As will be seen from the engraving, the engine has really no bed-plate, the casting to which the support for the cylinder and the crank-shaft plummer-blocks are bolted being merely a light cast-iron tray to catch any oil, &c., dripping from the guide bars and bearings. The strains due to the thrust and pull of the connecting-rods are taken by the guide-bars, these being bolted at one end to the cylinder-cover and connected at the other end to stays, which are secured to the crank-shaft plummer-blocks. The fly-wheel runs between the two plummer-blocks, while the crank-shaft, which is very short, carries a crank at each end, a pair of connecting-rods coupling the cranks to the cross-head, as shown.

The engine has a 6-inch cylinder, with 12-inch stroke, and the piston-rod is made of a piece of cold-rolled iron, not touched by the lathe. The valve-spindle, also, is made of a piece of round steel, used just as it left the rolls. A close examination of this piston-rod and valve-spindle showed that they had as good a surface, and were as perfectly cylindrical as they would have been if carefully finished in a lathe, and there can be no doubt that the use of cold-rolled iron and bar-steel in this way is a matter well worth the attention of makers of small engines. Mr. Pickering's engine is fitted with an ordinary slide-valve, the motion being transmitted from the eccentric to the valve-spindle through a rocking-arm. The engine is controlled by one of Mr. Pickering's governors, an arrangement which will be readily understood from the engraving. We need merely remark here, therefore, that this governor has three balls mounted on springs of thin plate-steel, the deflection of these springs, as the balls fly outward, drawing down the collar to which the springs are fixed at their upper ends, and thus closing, to a greater or less extent, a tubular equilibrium-valve contained in a valve-box below. The whole arrangement is very neat, and the governor acts promptly.

122. A distinctive feature connected with the engine we are describing is the manner in which the power is taken off from it. To render the engine compact, the fly-wheel is made very narrow, and instead of being made to take an ordinary flat driving-belt, it has a V-groove

formed in its periphery, this groove receiving a peculiar form of driving-band, invented by Mr. Charles Underhill, of Tolland, Conn. This driving-band, of which a short length is shown in the illustration, is made of leather, and is of V-section, the inner or thin edge being notched, as shown, so that the layers of leather on the broad side of the V only are continuous, and the band is thus perfectly flexible. In fact, instead of being considered as a band of V-section notched along the thin side, Mr. Underhill's driving-belt may, perhaps, be better described as a narrow belt having fixed to its inner side a number of teeth built up of thicknesses of leather, and of V-section. The pulley on the shafting to be driven is, of course, grooved, like the fly-wheel, and the belt being gripped by the grooves, can be run very slack without giving rise to slipping, thus reducing the strain on shafting and bearings. The band can also be lengthened or shortened as readily as an ordinary belt, and altogether Mr. Underhill's arrangement of driving-gear is one which promises to do good service in many situations. The engine exhibited by Messrs. Pickering & Davis at Vienna ran steadily at 150 revolutions per minute.

ENGINES WITH MISCELLANEOUS ARRANGEMENTS OF VALVES NOT INCLUDED UNDER THE PRECEDING HEADS.

123. There were at Vienna some half dozen engines which could not correctly be placed in any of the classes we have previously described, and among them some of very great interest. The American horizontal engine, 12 inches by 24 inches, to which we have previously alluded as having been built complete from the pig and bar iron in three weeks, was fitted with balanced piston-valves to cut off at .6 of the stroke. It was made by the Norwalk Iron Works, South Norwalk, Conn. Its framing, which is not unlike the Corliss framing in appearance, but is not hollow, has the peculiarity that the cylinder itself, and not only the front cover, is cast along with it. The bearings are placed at an angle, but the bracket which supports the outer or separate bearing is made with awkward curves, not well adapted to withstand either vertical or longitudinal stress. The governor is on Pickering's patent, which seems to give great satisfaction, as it was used on all the American engines at Vienna. The crank of the engine just mentioned is of cast-iron.

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124. Conclusion.—In concluding this section of our report, we propose to point out some broad characteristics of the continental engines and make some general remarks on them. It is fair to start by premising that neither England nor Austria can be fairly judged simply by taking an average of the engines they exhibited at Vienna. For England, it will have been noticed that many of our best engine-makers were conspicuous by their absence, and that we had not a single specimen of a really large factory-engine exhibited, while in Austria a dis-

proportionate number of very inferior makers exhibited, very naturally, as an advertisement, as it was so easy and cheap for them to do so, The engines from America, too, were by no means fairly representative of that country, or at all equal, either in workmanship or in originality of design, to the American machinery which they drove. There were only four of them altogether, and two of these were small common verticals. It may be taken that the engines from Germany, France, Belgium, and Switzerland pretty fairly represented the better class of engineers of those countries; and in speaking of Austrian engines we will not include in comparison some four or five which were obviously a long way below the general average of the Austrian makers. Some of the smaller nations, as Denmark and Sweden, although they had exhibits, can scarcely be said to have been "represented" in any proper sense, while Spain and Portugal sent nothing whatever. In comparing continental work with English, therefore, it must be understood that we do not so much refer to the English engines at Vienna as to the average run of good English work generally.

Through the whole Machinery Hall one broad distinction was observable between English and continental makers, a distinction which determines to a very great extent the character of the machines made, and which, it may be remarked, extends itself to the locomotives as well as the stationary engines. The English engineer, while he wishes economy of steam, thinks more of simplicity and cheapness, unlikeliness of needing repairs, and ease of making them. The continental engineer, on the other hand, while not forgetful of these latter points, is willing, to a far greater extent than is the case with us, to sacrifice them to securing a high steam efficiency. Thus, in the English section we found almost every engine with a steam-jacket, although there was at least one important exception to this rule, and an adjustable expansion slide-valve, but only very few in which the cut-off was controlled by the governor, while even in these few only the ordinary slide-expansion was used, and the connection with the governor was of the simplest possible. In the continental engines, however, that is, in those constructed by makers of the same standing in their own countries, as the English makers in Great Britain, the great majority had their cut-off valves controlled by the governor, and of these a very great number had some special valves and gear arranged for an instantaneous cut-off. It is not our object, just now, to discuss the relative merits of Corliss valves, double-beat valves, and slides; but one point in relation to them seems very much forgotten, and it may be well to point it out here. One of the principal objects of using Corliss or other instantaneously-closing valves is certainly to obtain a sharp cut-off corner in the indicator-card. At the same time few engineers would recommend any such gear in any engine but one intended to cut off early, certainly not to have a normal cut-off later than $\frac{1}{6}$ to $\frac{1}{8}$ of the stroke, in many cases, of course, not so late. At this period of the stroke, however, the actual

speed of the piston is but slow, (even when the engine is running fast,) and, as a matter of fact, an engine with properly-arranged expansion-slide, worked on the back of the main slide by an eccentric opposite the crank, will give a corner in the diagram as sharp as the most efficient spring-gear which we have seen, if the cut-off be not later than that which we have mentioned. The extreme importance which is attached to an economical use of the steam on the continent was almost ludicriously shown in one or two engines which the makers had thought proper to fit up with elaborate valve-gear, while, as yet, they had not attained sufficient experience in their profession to design a cross-head or proportion a connecting-rod. Of course, besides giving the sharp cut-off, the Corliss valves and gear have the advantage of requiring less power to drive them than ordinary slides, but this is a matter which we need not enter into here.

125. We examined with great interest the exhibits in Group XXVI, (education,) which had been sent by various technical shools and colleges in Austria and Germany. The teaching-apparatus, and also the curriculum, seemed most complete, and as if the latter embraced every point (by no means excluding, as some people imagine, practical work, but, on the contrary, laying much stress on it) necessary to make a young engineer's education complete. We even contrasted sadly in our minds the English system—or absence of system—of training engineers, with the completeness of the continental apparatus for the same purpose. Judging from results, however—and this is certainly the most or only satisfactory criterion—the difference is not at all what one would suppose; indeed, the advantage, we can say it after an impartial examination of the engines in the Machinery Hall, still lies with us. It is unquestionable that the most ingenious devices in the Exhibition (the Bede, Berchtold, Dautzenberg, or Radinger valve-gears, for example) all come from continental engineers. But whatever deficiencies English engineers have, they are certainly not deficient in mechanical ingenuity, and the fact that they have not produced such things (which we must not be supposed to dispraise) must be laid at the door, not of our defective educational arrangements, but of the fact that such machines would find no market with us, and that, therefore, there is no inducement to design them. These things, too, owe much more to the high degree of mechanical ability possessed by the individual inventors than to the educational system under which they have been trained. Polytechnic schools can neither make nor mar born mechanicians—such men will always come to the front—but their influence ought to be seen in the general designing and proportioning of the machines made by their scholars in after life. Not one English engineer out of twenty has ever been taught how to proportion a crank or find the diameter of a connecting-rod, and too many apprentices have grown up into men (at least one has had the impertinence even to write books) cherishing the fond idea that they were somehow connected with the "depth of cup of

gland," if not with the length of the boiler-tube. They have been left to pick up their theoretical knowledge in a haphazard way, and unless they are enthusiasts in their profession, possibly they never pick up any at all. But just these things the technical schools teach, and, therefore, just in these points we should expect *à priori* to find continental engineers ahead of our own. Whatever may be the reason of it, however, a matter we cannot go into here, it is a fact patent to any one who may take the trouble to examine for himself that really more obvious blunders in proportioning are made by Austrians and Germans than by ourselves. In one of design they are ahead of us; they have adopted the "Corliss" system of bed-plate (or some analogous design) to a much greater extent than it is used in this country, and we should think it probable that their example may after this be more largely followed among us. There can be no doub that this form of bed-plate is preferable in all cases where it is not necessary, on account of sudden shocks, as in rolling-mills, &c., or for any other reason, to give the engine more weight than is necessary for strength or stiffness. With the Corliss bed-plate, a simple form of guide supersedes the cross-head and guide-bars, which are clung to with so much tenacity by many English engineers. Apart from this matter of design, however, and looking to the proportioning of the different parts of the engines, there is much room for improvement, and even engineers of reputation have made some bad mistakes. These arise from several causes, all of which a proper education should have provided against, but principally from three, viz, ignorance of the right way in which to proportion different parts to resist the stresses to which they are subjected, ignorance of the best proportions for rubbing-surfaces, and ignorance of the proper factors of safety to use in different cases. We must not be understood as accusing continental engineers *en masse* of failing under these three heads; but these are just the points in which one would expect them to excel, and, as a matter of fact, they do the opposite.

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Under this head there also came a number of double-eyes, and, in some cases, a whole connecting-rod, of which the diameters and other dimensions seemed to have been guessed, and guessed badly. The second head is less important, but covers some very deficient piston-rod-head guides. The third head is specially noticeable where there are long rods in compression, either in the valve-gear or in other places. Some of these are far too light. There are few practical engineers but will bear us out in saying that a factor of from 16 to 20 is often, by no means, more than sufficient to insure stiffness in such rods.

The ingenuity which has been so successful in inventing valve-motions has not always been accompanied by a proportionate amount of common sense in working out their details, and particularly is this shown in an almost touching belief in the absolute rigidity of wrought iron, and an apparent idea that brackets, levers, and pins may be to any extent

overhung and yet work accurately. This certainly received most striking illustration in the locomotives, where we noticed in one case that the distance from the face of a wheel to the outside of the outside eccentric was no less than 19 inches, or about 26 inches from the nearest end of the axle-bearing, but it is also sufficiently evident in the stationary engines.

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It is worth while to note that the practice of having the main bearing-brasses adjustable in two directions, which is making considerable progress in England, is very general on the continent, nearly all engines making any pretense to excellence being fitted in that way. Almost without exception the connecting-rods are made with strap ends, or, at least, made to tighten with a gib and cotter. The various modifications of the old-fashioned arrangements are, some of them, very neat and commendable, as will be seen in our detailed illustrations of the engines. It is somewhat to be wondered at that not one single maker exhibiting at Vienna hit on the idea, comparatively common with us, of forging the piston-rod head in one piece with the rod. Even in the one or two cases in which the head was fitted with bolts, it was made separately, and keyed on to the rod. Although the key does not reduce the area of the rod below that at the bottom of the thread behind the piston, there still seems no sufficient reason why it should be cut, when forging the head in one with the rod is such a simple operation.

126. The workmanship shown in the continental engines was, on the whole, good; but there was certainly often a want of solidity and of finish about it, which is difficult to describe, but which becomes intelligible enough after examining such an engine as Galloway's or Messrs. J. & H. Gwynne's. Some of the Austrian engines, as we have already said, were very bad, though no worse than we should expect to see in some English machines at a similar exhibition in England. The castings, however, could scarcely rank along with the machine-work of the engines; they were in most cases much inferior to it. Besides that, they were rough and unfinished looking; the mistake was made over and over again of making the fillets in the corners far too small, which gave one the unpleasant feeling that they might crack at any moment.

It is very greatly to be regretted that such an opportunity as that which was offered at Vienna was allowed to pass by without advantage being taken of it to carry out a series of comprehensive trials of engines and boilers. The neglect of such an opportunity is a matter for which the Exhibition authorities will ever be blamed, as by taking advantage of it they might have added most materially to our knowledge of steam-engine performance, and furnished data of great and permanent value. It is, in fact, not too much to say that such engine and boiler trials, if carried out as they should have been, would have done more to make the Vienna Exhibition memorable than anything that could have been devised.

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HYDRAULIC MOTORS.

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127. Commencing our survey at the western end of the Machinery Hall, we found in the American department the Capron Water-Wheel Manufacturing Company, of Hudson, N. Y., exhibiting a turbine on Capron's patent, with vertical shaft, outer admission, eccentric casing, and without guide-blades. The buckets are provided at the discharge-ends with peculiarly-constructed funnel-like enlargements. The regulation of the water is effected by a rectangular throttle-valve placed in the admission-pipe. The construction of this turbine leaves, no doubt, much to be desired, but it is exceedingly simple in all its parts, and possesses one great advantage, namely, that all these parts are easily accessible.

AGRICULTURAL MACHINERY.

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128. Very few plows were exhibited in the Agricultural Hall belonging to the United States, nor were any of them specially remarkable for excellence of design or detail. Messrs. Collins & Co., of Hartford, Conn., showed a large two-horse plow, their so-called "Eclipse," which was a remarkably fine piece of work, but fit only for exhibition. A similar plow in another part of the hall was a practical implement, but of decidedly inferior workmanship. The principal feature of the plow, apart from the frame and seat for the driver, (an arrangement entirely unsuited for continental farmers,) is the introduction of two levers operated from the seat. The first and right-hand of these places the shares in position, the second, which is the most used, and is very inconveniently situated for the driver, is employed to lift the shares out of the ground. Attached to the lever is a saddle-shaped clamp, which clasps the rim of the wheel, and when it is desired to lift the plow, this saddle is pressed upon the tire so that the work of raising is done by the team. The depth of furrow is set upon a quadrant with a sliding stop, against which the lever is moved up. The two wheels are of the same size, and are mounted on cranked axles. The same makers showed a couple of neatly-made hand-plows, with steel mold-boards, shares, and land-sides, the shares being of the form shown, with points cast solid for a depth of 3 inches. The simplest form is without any forward or gauge wheel, but in the sole of the standard carrying the share, which is fastened to the beam, there are two slots, by means of which an adjustment can be made for varying the depth of the furrows. In another form, a wheel, mounted exactly as in the Ransome plow first noticed, is employed, the quadrant sliding in a similar manner on the beam. The link for the draught is held to the beam by means of a pin, the upper end of which forms the spanner for tightening or loosening the bolts.

129. A plow made by the Peekskill Plough-Works, New York, was

shown. It is entirely of cast iron except the share-pins and stilts, and a merit is claimed by the inventors for the use of the peculiar curved beam, it being urged that the draught is brought into a proper line with a shorter beam than is possible if the latter is straight. It will be noticed that the point of the share is prolonged, a good feature, as it allows for wear. The beam is cast with three ribs on it, and at the rear it is extended out so as to form the body to which the share is bolted.

In the implements provided with a front or skimming share, the standard of the latter is made with a rack upon its inner face, and is raised up or down by means of a pin in the side of the beam.

130. Messrs. Furst & Bradley, of Chicago, showed a good and simple hand-plow, with a rolled-iron beam of I-section; the point of the share is very long, to allow for wear, as in the one previously noticed. Besides these, there were a few other makers, who, however, exhibited nothing worthy of mention, and it is fair to assume that the United States failed altogether in being represented in this branch of industry.

IMPLEMENTS OF TILLAGE.

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131. In the American Agricultural Hall, Messrs. Deere & Co., of Moline, Ill., showed their so-called "Advance" hoe, a well-finished implement, with eight broad tines arranged in two groups, each mounted in a subframe, hinged to the forward part of the main frame, and connected with handles at the back. The handles rest on a cross-bar of the main frame, and are easily moved to and fro by the man in charge, who is thus enabled to steer the implement perfectly. The inner side of each group of tines is protected by a shield to prevent injury to the leaves of plants between the rows of which the implement passes.

132. A detail may be noticed in this same hall among the very few implements exhibited. It is the mode of forming the blades of cultivators adopted by the Remington Company, of Ilion, N. Y. The tine is bent up out of a flat steel plate, and the end is partly cut away, and the rest turned round into a tube, at the end of which a screw-thread is cut for the fastening-nut. A washer fits over the open heel of the tine, and has four small lugs cast on one side of it, between each pair of which one blade of the heel goes, while in front there is a small central lug, to enter the wood of the implement and keep the whole in place.

133. A very ingenious implement, known as Nishwitz's pulverizing-harrow, was exhibited by the New York Plough Company. It consists of a triangular frame, with a driver's seat mounted upon it, and carrying a number of sharp-edged and concave disks, set at such an angle in relation to the line of draught that in revolving they pulverize the soil, cutting-lifting, and turning it over in small furrows. A scraper is provided for each disk, so as to keep it constantly free from dirt. The implement is said to do admirable work in mixing the soil with fertilizers. In point of construction, it contains a good detail for attaching the disks. A bolt

passes through the frame and is secured by a nut. The lower end of this bolt has an eye, in which is secured a short pin serving as the axle of the disk. The bolt runs through a cast-iron cone placed under the frame, and abutting against the projection formed at the bottom of the bolt. The disk shown in section in the sketch fits loosely on the pin, and is prevented from falling off by the scraper fastened to the under side of the frame. Besides its cheapness, this arrangement has a special advantage, that of allowing a lateral movement to the disks.

DRILLS.

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134. In the American hall, two makers, Messrs. Thomas & Mast and Messrs. Ludlow & Co., both of Springfield, Ohio, showed each a combined drill and broadcast for clover, &c. In these implements the barrel-shaft is below the seed-hopper, which has a number of small holes at the bottom, corresponding to the number of drills, and the cups are formed in wheels mounted on the shaft, and revolving in such a way as to take a small quantity of seed in each cup and drop it into the tube. The broadcast comprises an independent hopper on the side of the other one, with a notched board within it, and extending for its full length, working to and fro by means of a connecting-rod and crank on one of the geared wheels; the notches alternately cover and expose holes in the hopper leading out to short sheet-iron sills extending the length of the hoppers. From these sills the seed is scattered on the ground. This is in Messrs. Thomas & Co.'s machine. In the other, the arrangement is similar, except that the sill is continuous, which is an improvement. There are a variety of ingenious details about these machines which, as they are never likely to prove useful to English makers, need not be noticed.

REAPERS AND MOWERS.

135. In considering this subdivision of the agricultural machinery exhibited at Vienna, we propose to deviate somewhat from the geographical order we have previously adopted, and to commence with a consideration of the exhibits which showed the most striking originality of detail, and which have been more or less freely copied by all European manufacturers.

The United States, then, exhibited undoubtedly the best and most instructive collection of reaping and mowing machines in the Exhibition, and this arose, to a great extent, from the fact that in the east of Europe American manufacturers have established business on so extensive a scale that English makers are unable to compete with them. All the great manufacturers in the United States were therefore fully represented, not as strangers, but as the recognized suppliers of the ever-increasing demand in the agricultural districts of the south of Russia, Austria, Hungary, &c. It is not surprising that in reapers and mowers the United States should enjoy so great a popularity. As much

ingenuity and skill have probably been displayed there in the improvement of these implements as in the perfection of sewing-machines, and there is scarcely a crooked piece of iron in any one of the reapers that were on view at Vienna that is not the subject of at least one patent. The American implements have, moreover, special advantages, which recommend them strongly to the purchasers, where the European trade is largest. The corn-growing districts of Hungary and Russia correspond closely to the great grain-producing areas of the United States, so that the machines perfected for the latter conditions are, of course, well suited to the former. Another point much neglected by all but American makers of these implements is the comfort of the men in attendance. At best, English reapers have a seat supported on a long bracket, on one side of the machine, out of the way of the revolving-rakes, but so placed that the horses have to be driven in an inconvenient position. This is not seen in American machines of any standard type—comfort to the driver in charge of the implement being a leading and very necessary as well as economical consideration. In the American machines the rakes do not revolve in a fixed plane, but, as they rise from the back of the platform, are gathered up into a nearly vertical position, so as to be out of the way of the driver, who can therefore sit fairly behind his horses. Leaving aside for the moment the consideration of comparative ingenuity displayed by American and other makers of reaping-machines, we are forcibly brought to the conclusion that the workmanship in the former is more suitable, and in many respects far better than in the latter. For example, the same peculiar skill which is shown in the construction of American carriage-wheels is seen in the wood-work of the reapers, especially in the rakes and platforms, the combination of strength and lightness in which is remarkable. Lightness in every part, indeed, is a special characteristic of these implements, as compared with English and continental machines of the same class, and this specialty, which perhaps was first forced upon American builders to suit the horses of their home-farmers, is equally appreciated in Russia and Hungary, where a light draught is all-important to conform to the capacity of the average horses. The special object of the American builders appears to be to combine strength and efficiency with lightness and cheapness of construction, at the expense no doubt, to a certain extent, of durability; but apparently it suits the American farmer to purchase machines at a moderate price that may wear out in a few years, but not before they have paid for themselves many times over, and which, if they were more durable, would probably become comparatively obsolete long before they were past service. It would seem as though the American makers have succeeded in making their European purchasers adopt the same ideas.

136. Turning now to a somewhat detailed consideration of the reaping and mowing implements that were exhibited by American makers, the stand of one of the leading firms, the Walter A. Wood factory, of

Hoosick Falls, New York, at the eastern end of the Agricultural Hall, first claims attention. There were exhibited here one "New Champion" and one chain-rake reaper with two mowers. The Wood factory occupies a leading position in this trade, and has turned out, since the business was commenced in 1848, no less than 160,648 implements, of which the "New Champion" is now a favorite and valuable type. In this machine the motion is given to the cutters in the usual way, but the mode of working the rakes is extremely simple.

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The bottom of each rake-arm terminates in a roller, which presses against the side of the cam. It will be noticed that a path for the rollers is made around the bottom edge of the cam, and that this gradually changes from being nearly vertical, and corresponding to the highest position of the cam, to the opposite side, where the path dies off from the side, and turns beneath the cam. The rakes are coupled together in pairs, and, as the ends of these rods are attached to slotted links at the sides of the arms, the distance between them being regulated by shifting the position of the links, the rakes may thus be worked in pairs, if desired, instead of all four being employed, the shortening of the distance between them having, of course, the effect of throwing up the pair thus adjusted clear of the platform, when it is wished to regulate the size of the sheaves. An ingenious adjustment is employed to keep the rakes always parallel with the cutters when they reach the platform. This reaper has a very efficient steering arrangement under the control of the driver, and the height of the platform, the cutters, &c., can be adjusted at will. The same makers exhibited, also, a chain-rake reaper of ingenious construction, but certainly neither so practical nor efficient an implement as the one just described, although it is stated that they are largely used in the States. Gearing, consisting of one wheel fixed on the driving-shaft of the implement, an intermediate wheel, and a third attached to the outer end of the spindle, complete the means for driving the chain. The table is of the form shown in the sketch, and at each corner is a pin, which forms the center of a small pulley, over which passes the chain. This chain is driven round constantly by means of gearing worked from the spindle. The rake is of the form shown. It is hinged to a part of the frame-work of the implement, and the other end of the rake is attached to the chain, there being an intermediate hinge, as shown. The chain constantly moving carries with it the rake, which sweeps the whole area of the table at each complete circuit. This arrangement, though effective as far as it goes, is open to the objection that it does not afford a means of regulating the size of the sheaf thrown off, as in the implement by Mr. Wood just noticed. It appears, also, more liable to get out of order, and unsuitable except for crops in good condition. This implement is furnished with a four-armed flier driven in the ordinary way by a pitch-chain of the main shaft.

137. In the next stand, Messrs. Aultman, Miller & Co., of Akron, Ohio, one of the firm of manufacturers of the Buckeye machines, exhibited their combined reaper and mower, two mowers, and a reaper fitted with Millar's revolving table, which implement has, at least, novelty to recommend it. The motion is taken off a bevel-wheel on the axle of the implement, by means of a pinion, to a spur-wheel quite at the rear of the machine, which drives in its turn a small pinion, the spindle of which passes from the back to the front and drives the cutters. A second pinion, taking motion from the same bevel-wheel on the main shaft, actuates the revolving table which forms the special characteristic of this reaper, and which will be understood from the sketch. On the platform is mounted horizontally an iron disk, to which is attached a vertical board with three teeth, forming the rake. The table is caused to revolve by suitable gearing driven by the connecting-rod, which has two universal joints in it. The operation of the machine is very simple. On advancing into the crop, the stalks, cut by the cutters in the usual manner, are swept on to the platform by the rake as it revolves with the table. The size of the sheaves gathered can, to a certain extent, be regulated by the driver, who, by stopping the motion of the table, may allow the grain to accumulate on the platform, as he desires. It will be seen that the implement, however, possesses no means of bringing laid crops to the knives, the function of the rake being simply to deal with what is brought up to the cutters. The means for driving the table are, moreover, open to objection, and the connecting-rod with the universal joints lies very close to the ground, so that it of necessity must become impeded by the straw that wraps around it.

138. Adjoining Messrs. Aultman, Miller & Co.'s exhibits were those sent by the Johnston Harvester Company, of Brockport, N. Y., and who showed one reaper, one combined machine, and one mower. The type of machine manufactured by this firm has many excellent features, the combination of which, together with the good workmanship, tend to make the Johnston implements the leading favorites in Russia, where they are sold in large numbers. The chief features of the implement are an excellent variety of the Johnston rake and the arrangement of the driving-gear, which is well elevated, and horizontal instead of vertical. In common with many of the better class of implements, it possesses easy means of adjusting the position of the rakes with reference to the cutter, of regulating the height of the platform, and of tilting the implement at will.

The chief features of the Johnston rake are a switch in the roller-cam, and appropriate mechanism for throwing open this switch when it is desired to alter the curve of the roller-path and lift one of the rakes clear from the platform in order to regulate the size of the sheaf. When all the rakes are permitted to sweep the platform, the cam-switch is kept shut and the rollers traverse the outside of the switch, but when one or any greater number of the rakes are to be thrown up, the switch

is opened at the proper moment, either by hand or by suitable mechanism, and the roller enters its new path. In the original form of the Johnston switch, the latter had to be closed by hand, and it was only after a considerable period that the idea occurred to another inventor, and formed the subject of a second patent on this small piece of iron, to finish the cam with a tail-piece, inclined inward, and of such a form that it should project over the roller-path, and be struck by the roller in its onward movement, the blow closing the switch, and completing the path for the next rake. In the Johnston Harvester Company's implements the motion of the switch is made automatic in the following manner: upon the vertical shaft, carrying at the upper end the cap upon which are hinged the ends of the rake-arms, is mounted a wheel to which a vertical movement can be given by means of a lever actuated by the driver from his seat. On raising the wheel, it is thrown out of gear with a second toothed wheel running free on a short spindle. It will be seen, by referring to the accompanying sketch, that the wheel on the vertical shaft is divided into five parts, corresponding to the number of rakes used in the implement, and that the loose wheel has a line marked upon it. Care must be taken in putting on this wheel that the tooth marked thus enters one of the spaces marked in the other wheel, in order that the opening of the gate or switch may be effected at the proper moment. Upon the wheel is a curved inclined path, concentric with the wheel. Several of these wheels, of different sizes, are supplied with each implement, and regulate the number of rakes which are to be thrown up or made to sweep the platform. When it is desired to increase the number thrown up, a smaller change wheel is introduced, and thus it will be seen that the action of the rakes is entirely under the control of the farmer, who adjusts the implement before entering the field. Resting on the top of the inclined curved path of the wheel is a small horizontal latch, which is coupled by a lever to a pin on which the switch of the cam turns; a strong spring always tends to keep this latter open, but the impulse is resisted by the pressure of the latch against the inclined path. When, however, the wheel has been driven so far round that the incline has cleared the under side of the latch, an event which occurs just at the moment when the roller of the rake-arm has to enter the inner curve of the cam, the latch is thrown back by the spring, the switch opens, and the roller passes, but, in going forward, it immediately strikes the tail of the switch, and the blow compressing the spring forces the latch back again over the incline on the wheel, and so restores the arrangement to its normal position.

A neat mode of securing the hinge-pins of the rake-arms is seen in this implement. The ends of each pin abut against the adjacent ones, so that they lock each other, and the joint is made without any fastenings whatever, excepting that one end of the fifth pin is secured by a set-screw against which it rests. The whole of the gearing by which the rakes and cutters are driven is arranged, as we have said, horizon-

tally, with the exception, of course, of the beveled spur-wheel attached to the driving-wheel of the implement. The crank driving the cutter-bar is vertical, and runs in upper and lower bearings.

The mowers of the same company are well-designed and carefully-made implements, though probably they are a shade inferior to the Wood mower. One feature about them may be noticed. The gearing is actuated by the driving-wheel through an internal ratchet-wheel and four pawls which drive the implement in its forward motion, but run loose in backing; the pawls may also be thrown out of gear by a hand-lever, and the mower run in each direction on free wheels.

139. Messrs. Warder, Mitchell & Co., of Springfield, Ohio, exhibited an excellent "Champion" reaping-machine, which made a good show among the highly-finished implements in this hall, although it is an ordinary machine taken out of stock; on the other hand, the mower shown by the same firm is highly finished.

The Champion machines enjoy a high reputation in the United States, and the exhibitors have three works in Springfield, each of which finds occupation for 300 men.

The Johnston rake with four arms is employed, with an automatic arrangement for throwing open the switch, different to that we have described as in use on the Johnston harvester; the switch is, moreover, under the control of the driver, who, by means of a chain, can open or close it at will. The arrangement for tilting is simple, consisting of a lever beside the driver, from the end of which a chain passes over a quadrant and is fastened to the platform. On the under side of the bar, and at its extremity, is a cone which fits in a corresponding tapered hole in the end of the cutter-bar; a spring placed on the top of the connecting-rod engages the teeth of a ratchet-nut, which secures the pin passing through the cutter-bar, and the cone at the end of the connecting-rod, and securing them together. It will be seen that any wear can be taken up by turning the nut, which is kept in place by the spring.

140. The Excelsior machine, which was exhibited by the J. F. Seiberling Company, of Akron, Ohio, is peculiar in having a delivery directly behind the platform instead of at the side, so that when working it must be followed up by laborers to bind the sheaves. The grain is received upon a table, which can be tilted at the will of the driver, and the sheaf made of any desired size, thrown on the ground. This delivery in the path of the machine is open to many objections, and the implement, taken as a whole, does not compare favorably with the other exhibits which we have described.

141. One combined reaper and two mowers were exhibited by Adriance, Platt & Co., of New York. It is this firm that purchased the Buckeye patent-rights, in 1857, for the Eastern States, Messrs. Aultman & Millar having secured for the Western States similar privileges in that year, for the same machine, which had been brought into notice at the agricultural trial held in Syracuse, N. Y., in 1857. The Buckeye

implements are well arranged, the frames made light and strong, and the connections between the machine and the platform are ingenious. The wheels can be made to run either fast or loose on the shaft, so that when not in actual operation there is no unnecessary wear on the working parts of the machine. In the combined machines, the platform, detached from the body of the implement, can be trailed behind, a small extra wheel being provided.

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142. The Burdick reaper, and the Kirby combined mower and reaper, were shown by D. M. Osborn, of Auburn, N. Y. The rake is similar to the Johnston, but the arms are thrown up by lifting a part of the cam which is hinged, and thus altering the angle and direction of its path. This is done by suitably-arranged levers worked by the driver. The whole of the mechanism of this implement has the disadvantage of being very near the ground, and although an ingenious arrangement, the rake does not compare with the Johnston. In the combined machines made by this company, only one large wheel is employed instead of two, a small additional one being added when the implement is used as a reaper.

Mr. Fussell on Educational Appliances.

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143. The dimensions of the American school-house are: Length, 33 feet; breadth, 26 feet; height, 13½ feet; floor-area, 858 square feet, or at the rate of 7.87 per child; cubical feet of internal space, 11,583, or at the rate of 241.31 per child, the room being calculated to receive 48 children.

The benches are well finished and commodious, but less carefully graduated for children of various ages than were those of Sweden; the lighting also is not quite so well managed, there being windows on three sides. The arrangements and fittings are very good. Due provision is made for instruction in geography, zoology, botany, and mineralogy.

There was a very interesting model of the Franklin school in Washington. It is calculated to receive 64 children in a class, and the lighting and ventilation are well arranged. The model was said to have cost $1,000. There were also some striking photographs of other school-buildings.

The estimated cost of the schools in Massachusetts is $34,000,000; the cost of those of the city of Boston alone is said to have been $6,500,000.

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Maw and Dredge on Building-Materials.

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144. Specimens of a fine sandstone, known as Connecticut freestone, were shown in the United States section, a material largely employed

in New York and other towns, on account of its beauty of appearance and ease in working it. The first sample shown was of a very fine quality and small grain. A coarser stone is adapted for building purposes; and the third, hard and of considerable density, is largely used for foundations. Fifth and Madison avenues, New York, show many examples of this stone, while it is employed upon numerous public buildings, such as the new State-house in Hartford, Conn. Its comparatively low price, about half that of granite, has created for it a large demand, and renders its use economical, even when it has to be transported to considerable distances. The Middlesex Quarry Company, Portland, Conn., contributed these specimens.

Blocks of yellow sandstone were also sent from Cleveland, Ohio, partially carved, in order to show the cleanness and facility with which it can be worked. Cubes of white, red, and black marble, pieces of granite from Burlington, Vt., and a number of samples of red-veined marble from Champlain, completed the whole of the exhibits of this class contributed by the United States.

Iron and Steel.

145. All political economists appear nowadays agreed that, next to coal, there is not one of nature's gifts of such paramount importance for the industrial and political power of modern nations as iron, and the quantity of its production offers a fair standard for their wealth and importance. The total production of the globe, with regard to pig-iron and malleable iron made direct from the ore, is estimated at 15,322,500 tons per annum approximately, and it is divided among the different countries as follows, in round figures:

	Tons.
England	6,733,000
United States	2,800,000
Germany	2,664,000
France	1,182,000
Belgium	565,000
Austria-Hungary	425,000
Russia	360,000
Sweden and Norway	306,000
Italy	74,000
Spain	72,000
Switzerland	7,500
British and South America	50,000
Japan	9,000
Asia	40,000
Africa	25,000
Australia	10,000

These figures show at a glance the enormous preponderance of England, North America, and Germany over all other countries with respect

to their capability of producing iron, as they alone make two-thirds of the whole quantity, which, as it seems, is still not enough to respond to all demands.

We commence our present review with the United States of America, which rank second in the list of iron-producing countries, and can boast of a growth of their iron industry equaled by no other nation. We follow the Pottsville Coal Statistical Register in demonstrating that fact by the following figures. The produce of pig-iron in the United States was, in—

	Tons.		Tons.
1810	30,000	1866	1,350,343
1830	165,000	1867	1,461,626
1840	345,000	1868	1,603,000
1850	600,000	1869	1,916,641
1860	913,700	1870	1,865,000
1864	947,600	1871	1,912,608
1865	931,582	1872	2,830,000

These figures show that in sixty-two years the production has increased ninety-six times as compared with 1810, and under these circumstances a few words on the history of the development of the North American iron-trade will not be out of place here.

When, in the early part of the seventeenth century, our colonists settled on the Atlantic seaboard of North America, they seem to have got what little iron they wanted from the mother-country, and only after some lapse of time did they begin to make malleable iron direct from rich and pure ironstones in so-called ore-bloomeries and low wolf-furnaces. When treated by either of these processes ores which could be easily reduced to the metallic state in a charcoal-fire, such as carbonate or spathic iron-ore or brown manganiferous hematite, yielded a lump of metal, called a *pig* or *wolf*, (*loup* in Walloon countries,) still rather impure and mixed with slag, but which, when reheated and hammered properly, yielded an excellent kind of tough wrought iron. Charcoal blast-furnaces seem to have been first erected in the early part of the eighteenth century in the New England States, where rich iron-ore and large forests were at hand, and they followed westward in the wake of the ever-advancing pioneers as soon as iron had become a necessary of life in the new settlements. With the destruction of the forests these iron-works also closed their career, and charcoal blast-furnaces are at present only left in the New England States, New York, New Jersey, Pennsylvania, Maryland, as well as in Michigan, Alabama, and Tennessee, these furnaces having, in 1871, made 387,000 tons of pig-iron altogether. That their number was very restricted up to the year 1830 may be inferred from the annual production of only 30,000 tons in 1810, and 165,000 tons in 1830. After the use of anthracite coal or culm in blast-furnaces had been successfully introduced in South Wales by Mr. Crane and Mr. Budd, about the year 1836, it was carried over the ocean by a Welshman named David Thomas,

who, in 1837, started the first anthracite blast-furnace in America, at Mauch Chunk, in the Lehigh Valley, in Pennsylvania, where there are now over 40 furnaces in existence. The employment of anthracite as fuel for iron-making spread gradually to the valleys of the Schuylkill, the Upper and Lower Susquehanna, the Juniata, and to the eastern and northern districts of Pennsylvania, where, in 1871, not less than 873,000 tons of anthracite pig were produced by about 73 furnaces. The iron industry had meanwhile passed over the Alleghanies, and in Western Pennsylvania, in Clarion County, and in Ohio, at Youngstown and Zanesville, it found at its disposal beds of the so-called block-coal, which breaks into large lumps, is hard, free from sulphur, rather dry, and admirably suited for blast-furnace fuel in the raw state, just as are the similar coals of South Wales and Scotland. Numerous new furnaces were here erected and fed partly with native ironstone, partly with rich magnetic iron-ore from Lake Superior, and at Pittsburgh their number increased in a single year from 5 to 12, with a weekly produce of 3,600 tons. From thence the furnaces spread north and northwest to Lake Erie, to Cleveland, in Ohio, Mahoning, Chenango, and other places, and already in 1860 no less than 76 blast-furnaces and 24 forge-mills existed in Ohio, Indiana, Michigan, Illinois, Wisconsin, and Kentucky, among which were 5 at Brazil, in Indiana, 1 at Terre Haute, and 15 at Saint Louis. The latter furnaces were supplied with ore from the Iron Mountain in Missouri, which, in 1868, yielded 105,000 tons; in 1869, 195,000 tons; in 1870, 316,000 tons; in 1871, 500,000 tons of rich red hematite iron-ore. Almost all the other furnaces of Ohio and Indiana receive vast quantities of magnetic iron-ore from 16 mines of the Lake Superior district, which, in 1856, only yielded 5,000 tons; in 1860, 116,900 tons, and, in 1870, 856,470 tons of ore, besides 50,000 tons of pig-iron made in the district. Alabama promises also to produce large quantities of rich brown and red iron-ore in Talladega, Bibb, Shelby, and Cherokee Counties, as well as oolitic red iron-ore, with 50 per cent. of iron from the Red Mountain, between Gadsden and Tuscaloosa, which is estimated to contain over twenty milliards of tons. The number of blast-furnaces in the United States was, in 1872, 545, and in 1873, 641, of which number 83 were quite recently built. Besides these blast-furnaces, there are still at work numerous ore-bloomeries—a kind of Catalonian forge—which make iron direct from the ore, particularly so in the States of New Jersey and New York. Among the United States iron exhibits at Vienna we met with a bloom from such a bloomery, shown by the Clifton Mining Company of Saint Laurent, in New York, this bloom having been made from magnetic iron-ore belonging to the Laurentian or Azoic period; the same company exhibited likewise charcoal pig-iron of very good quality. Similar iron-ores and iron were produced by the J. & J. Rogers Iron Company, of Au Sable Forks, N. Y., by C. S. Johnston, of New York, and by Witherby, Sherman & Co., of Port Henry, N. Y.

From Indiana we found samples of ironstone and iron, by the State geologist, Mr. E. D. Cox, and a very good exhibition was made by the Brazil furnaces of Brazil, Clay County, Indiana, including six kinds of pig-iron made with raw block-coal, No. 1 being dark gray; No. 2, middle gray; No. 5, mottled, and No. 6, white pig. The Muddy Iron Company of Saint Louis, Mo., showed pig-iron, and John M. Krum, and the Ravola Iron Company, of Saint Louis, iron-ore, while Mendenhall & Kitchell, of Cincinnati, Ohio, brought forward good specimens of pig and wrought iron. The Irondale Company, of Jefferson, Ala., was represented by brown iron-ore and red oolitic hematite of the Devonian age, containing numerous shells of the genus Spirifer, while they also showed samples of gray and white pig-iron made from these ores with charcoal as fuel. Their blast-furnaces are 58 feet high, 7 feet diameter at the top, and in the boshes 12 feet, as are the furnaces of the Jefferson Iron Company, near Birmingham, and of the Red Mountain Iron Company at Ironton, Ala., which smelt the red ore mixed with black band from the coal-measures of the Warrior coal-fields. Richard Rothwell also exhibited iron-ore from Alabama, and E. B. Ward, of Detroit, Mich., magnetic, brown, and oolitic ore. Of particular interest was the collection of George R. Tuttle, of Cleveland, Ohio, which embraced fine specimens of specular iron-ore, magnetic ore, and hematite, from the principal mines in Marquette County, Michigan, which produce the famous Lake Superior ore. The Dunbar Iron Company, of Pennsylvania, exhibited samples of clay iron-ore, or spherosiderite, limestone, fire-clay, and three kinds of gray pig, made with coke from clay band, which produces a lavender-blue slag. Lastly, the collection of the North Pacific Railway Company included, also, specimens of fine brown hematite, and of charcoal pig-iron from Oregon.

MR. H. VIZETELLY ON WINES.

146. The samples of American wines exhibited at Vienna were not remarkably varied, still they enabled one to form a fair estimate of the produce of a land which is destined to become, like Australia, one of the great wine-producing regions of the world. There were merely 17 exhibitors, who, however, contributed among them as many as 82 specimens. Of four medals for progress which were awarded, one was secured by Messrs. M. Werk & Sons, of Cincinnati; the second by the Pleasant Valley Wine Company, of Hammondsport, N. Y.; the third by Messrs. Eberhart & Lachmann, of San Francisco; and the fourth by the Buena Vista Vinicultural Society. Of the three medals given for merit, two were received by New York firms, Messrs. Ellis & Curtis and Messrs. G. Groezinger, Ruyter & Co., the remaining one being allotted to Messrs. Poeschel & Scherer, of Hermann, Mo. Two other exhibitors received honorable mention. It is but just to add that the samples sent by the American Wine Company, of Saint Louis, Mo., had been placed *hors concours*.

Of the various wines submitted to the jury a marked difference was observed between those vintaged in California and those produced in other States, a circumstance due to the fact that European vines are almost exclusively cultivated in the former province, while in the Missouri, Ohio, New York, and other States, the indigenous varieties alone are grown. Of the different Californian growths, known under the names of Angelico, Aliso, Porto, &c., the best were those of Messrs. Eberhart & Lachmann, to whom, as already mentioned, a medal of progress was awarded. This firm displayed some capital Riesling wine, not unlike the original Rhenish growth, although by no means equal to the finer European varieties, while their Gutedel, sweet and dry Muscatel, and so-called Tokay and Mountain wines were carefully made and of fair average quality. The Californian Alisco proved to be a white wine with considerable body, and in taste not unlike an inferior Barsac; while some so-called sweet-grape wine might have been taken for one of the light, brisk, and delicate growths of the Jura.

Of the wines from Ohio, Iowa, Missouri, Mississippi, and New York, which were the only States besides California that exhibited at Vienna, those produced from varieties of the indigenous Labrusca vines were all more or less tainted with the peculiar musky or foxy flavor inherent in those plants, and which is so displeasing to the European palate. The Catawbas, still largely produced, in spite of that vine's liability to rot or mildew, and which Longfellow in his well-known song has described as "so dulcet, delicious, and dreamy," were of three tints—colorless, straw-color, and rose color—according to their age and to the treatment the grapes had undergone. In taste they were not unlike certain wines of the Rhine, but fuller to the palate, although containing merely the same amount of alcohol. The produce of the prolific Concord vine, said to be very popular in the United States, and by some preferred to the Catawba, was a bright, light-red wine, with the obnoxious foxy flavor, however, far too prominent for European tastes. The same defect was noticeable in a less degree in the wines vintaged from the Ives Seedling and Hartford Prolific vines, as well as that produced from the Isabella grape, which has a marked raspberry flavor, and was at one time an extensively-cultivated variety, but is now scarcely employed for purposes of vinification, owing to its liability to mildew.

The finest American red wines were those yielded by the vines known as Norton's Virginia and the Cynthiana. The former produces a well-blended, full-bodied, deep-colored, aromatic, and somewhat astringent wine, only needing *finesse* to equal a first-rate Burgundy. The second, probably the finer of the two, being a darker, less astringent, and more delicate growth. The Clinton variety furnishes a wine of about the same body as Bordeaux, but darker in color, and tainted with the obnoxious musky flavor. Among American red wines of note in their day, one may mention the produce of the so-called Schuylkill Muscadel vine, which was the only esteemed growth in the country previous to

the cultivation of the Catawba grape, being in fact ambitiously compared to the *crûs* of the Gironde. It was a bitter, acidulous wine, little suited to the American palate, and invariably requiring an addition of either sugar or alcohol to make it keep. The same is the case with the wine furnished by the Mustang grape of New Mexico, Texas, and Arkansas—

> "The fiery flood
> Of whose purple blood
> Has a dash of Spanish bravado."

So sings Longfellow, apparently unaware that in its natural state this wine is in reality a poor acid fluid, and that its "fiery" flood is exclusively due to the addition of 3 pounds of sugar to each gallon of must, combined with 10 per cent. of proof-spirit administered after fermentation, the result being a strong-bodied and sufficiently agreeable-tasting wine.

Of white growths, the sometimes slightly rose-color wine yielded by the Delaware grape proved the most delicate, resembling a Rhine wine in character, and possessing a fragrant bouquet. The Carolinian Scuppernong, which was not represented at Vienna, being of too feeble a constitution to travel any great distance, while the grape itself can hardly be cultivated north of 35° latitude, is a wine of the same class, but with a sweeter flavor. Next comes the Herbemont, a rosy-colored white wine, in taste reminding one somewhat of Spanish Manzanilla, and with a more agreeable freshness than Delaware, the Taylor, a Riesling-like growth, and the Cunningham, which has the character of Madeira. The Devereux vine, it may be added, also yields an excellent white wine.

Sparkling wines formed a considerable item in the American samples, the best known being sparkling Catawba, made by the same complicated process and with equal care as the *vins mousseux* of France. Some varieties are sweeter than others; some are a trifle acidulous, while all are very frothy, and have moreover too much of that musky perfume which Longfellow says "fills all the room with a benison on the giver." Apart from its scent the European wine, to which sparkling Catawba may be best compared, is perhaps effervescent Vouvray, while unquestionably the American sparkling wine most appreciated by the jury was the Californian Sonoma, which proved to be *droit de goût*, fresh to the palate, and not unlike a middle class Ai champagne.

From the earliest period of the colonization of America the vine appears to have attracted the attention of the settlers, and it is said that as early as 1564 wine was made from the native grape in Florida. The first attempt to establish a regular vineyard dates, however, from 1620, and would seem to have been made in Virginia with European vines, the prospects having become sufficiently encouraging in 1630 for the growers to send for French vine-dressers to tend their plants. The latter were subsequently accused of ruining the vines by their bad treatment, but most likely this was an error, it having since been made evident that

European vines cannot be cultivated east of the Rocky Mountains where the *Phylloxera vastatrix* prevails. It was in vain that William Penn made repeated attempts to acclimatize European vines in Pennsylvania; in vain that the Swiss emigrants made similar trials in Jessamine County, Kentucky; that Pierre Legaud labored in the environs of Philadelphia, and Lakanal, the member of the French Convention, experimented in Tennessee, Ohio, and Alabama; all their efforts to introduce the Old-World vines proved fruitless. The attempts made by the Swiss settlers at Vevay, in Indiana, with the indigenous plants were more successful, and after a time they produced some palatable wine from the Schuylkill Muscadel. Viniculture and vinification languished, however, in a precarious condition until attention was called in 1826 to the Catawba vine by Major Adlum, of Georgetown, near Washington, who thought that by so doing he was conferring a greater benefit on his country than if he had liquidated its national debt. This vine, which is derived from the wild *vitis labruski*, was first planted on an extensive scale near Cincinnati, by Nicholas Longworth, who is justly looked upon as one of the founders of American viticulture, and gradually supplanted all others, remaining for many years the principal plant cultivated along the banks of the Ohio, the so-called "Rhine of America," until, ceaselessly attacked by rot, mildew, and leaf-blight, it was found necessary to supplant it by more robust varieties.

The wines known as Norton's Virginia, Concord, and Clinton, form to-day the basis of the Missouri vineyards, which promise to become, not merely the most prolific vineyards of the States, but also those yielding the best wines. Hermann is the center of viticulture in Missouri, but grapes are also grown and much wine made around Boonville, in Cooper County, and Augusta, in Saint Charles County, also at Hannibal, on the Mississippi, and in the vicinity of Saint Joseph, on the Missouri, there being hardly a county in this favored State, which enjoys the advantages of longer seasons, a warmer climate, and more suitable soil than other regions, but has some flourishing vineyard. Inspired by the rapid success realized by Missouri both in viticulture and vinification, Indiana and Illinois, since 1848, have greatly extended the area of their plantations, Kentucky, Tennessee, Arkansas, Iowa, and the southeast of Michigan following somewhat less swiftly in the same direction. In the Northeastern States, where grape-culture is very disseminated, the greater part of the produce being employed for table use, the Concord variety grown on trellis-work over the houses or on arbors prevails; the Catawba, although still represented in the Missouri and Cincinnati vineyards, being now principally grown on the islands of Lake Erie and around Hammondsport, in the State of New York, where it is purchased by the Cincinnati and Saint Louis manufacturers of sparkling wines, and removed to their establishments. In the southeastern region, North and South Carolina, and Georgia, the Scuppernong, which is remarkably vigorous and prolific, is the prevailing vine. In Alabama and

Louisiana, lands of the sugar-cane, the culture of the vine is of small importance. Texas, however, can boast numerous indigenous varieties, the chief of which is the Mustang, while California is rich in European vines, it being calculated that in 1861 the vineyards of the latter State contained 10,592,688 plants; 2,570,000 in the county of Los Angeles, and 1,701,660 in that of Sonoma, and which have since probably more than doubled in number. The system of culture varies in the different States. In some parts the vines are trained on trellises, while in others they are fastened to stakes six or seven feet in height, being planted at distances varying from 3½ feet by 4, to as much as 12 feet by 12, on account of their greatly developed foliage and the large space between their shoots.

According to a report prepared by Mr. Erskine in 1858, for the British Government, the vineyard area in Ohio at that epoch was 3,000 acres; in Kentucky, 500; Indiana, 1,000; Missouri, 500; Illinois, 500; Georgia, 100; South Carolina, 300; North Carolina, 200; the total produce being estimated at 2,000,000 gallons of wine. To-day the vine is cultivated for wine-making purposes over 2,000,000 acres of ground, and the produce, which in 1840 was only 124,734 gallons, has risen to 14,000,000 of gallons. The small proportion of wine to the vineyard acreage is only to be accounted for on the hypothesis that the majority of the plants are young. As these get into bearing the production ought to increase thirty-fold and even beyond. At the present time California alone produces about 2,300,000 gallons, and it may be mentioned that in the single State of Ohio the vineyard area has increased in 1870 to 10,446 acres, yielding, however, merely 155,045 gallons of wine, owing, no doubt, to so much of it being newly planted. Vinification in the United States is still susceptible of many improvements. In some cases the vine-growers make their own wine; in others the grapes are bought up by the numerous wine companies established in almost every State, and whose operations are conducted on a vast scale in accordance with prevailing transatlantic notions. Their *cuveries* are immense galleries a couple of hundred feet in length by 80 broad, divided into three stories, the ground-floor containing the presses, six or more in number. The grapes on arriving from the country, brought by the different growers, are thrown into a basket running along rails, whence they are emptied into the weighing-machine, weighed, paid for, and thrown into a vast *cuve*, where, by means of a mechanical apparatus, they are transferred into a machine which slightly presses them and removes the stalks. The juice is conducted by pipes to the fermenting *cures* and the mash descends to the ground-floor to be placed beneath the presses. The latter are ordinarily worked by a steam-engine of 15 horse-power, but, if necessary, can be worked by hand. Only six hours are occupied in pressing three tons of mash, and such is the rapidity with which the operations generally are accomplished that in six minutes a ton of grapes can be received, weighed, crushed, the juice transferred to the fermenting *cures*, and the mash made ready for pressing. The smallest cellars of

these establishments can store 50,000 gallons of wine and frequently as many as 350,000 gallons; some of the tuns, which are remarkably well made, holding no less than 2,200 gallons each.

When the wine is made from the grapes of the *labrusca* group, the principal difficulty that has to be contended with is to prevent too much of the strong musky flavor of the fruit from entering the wine, and which is accomplished by removing the first juice expressed from the grapes and not allowing it to ferment on the lees. In this manner the dark red grapes yield a white wine, the flavor of which is not nearly so powerful as it would have been had this precaution not been taken. The extensive introduction of the Norton's Virginia and Delaware varieties, which are without this defect, has done much, however, to obviate the inconvenience. Many of the American wines contain an extremely small quantity of natural alcohol, and it has become the practice to follow out the theories of Dr. Gall—extensively in vogue, as we have pointed out, on the Rhine—and to add to the must, as already explained with regard to the Mustang grape, a certain quantity of sugar, calculated as being deficient in the fruit itself, and which varies from 1½ pounds to 3 pounds per gallon. The produce of the Concord grape is probably the wine which experiences this treatment to the greatest extent. The testing of certain Californian wines showed that the Sonoma Valley white variety was the one which contained the smallest amount of alcohol, indicating, as it did, under 15 per cent. of proof-spirit, while the red wine gave 17½. The so-called Californian hock showed as much as 24½, the Angelica 26, the Californian port 31½, and a Muscat wine upward of 33. During the year 1873, the State of California exported 1,097,742 gallons of wine, 38,657 gallons of which were consigned to Europe.

The only information which has reached me respecting the price of American wine is that still Catawba is sold at the rate of half a dollar per bottle, and that newly-vintaged Concord is 90 cents, or 3*s.* 9*d.*, the gallon, which is about what American wines on the average commaud. The sparkling wines are a dollar and upward per bottle.

In 1870 the United States imported 9,607,662 gallons of wine, valued at $5,801,000, or £1,208,541.

EXTRACTS

FROM

FRENCH REPORTS

REFERRING TO THE

EXHIBITS FROM THE UNITED STATES

AT THE

INTERNATIONAL EXHIBITION VIENNA, 1873.

TRANSLATED BY

I. T. THURSTON,

UNDER THE SUPERVISION OF THE EDITOR.

REPORTS OF THE FRENCH MEMBERS OF THE INTERNATIONAL JURY.

GROUP I.

MINERAL INDUSTRY.

Report of M. Gruner.

* * * * * * *

147. The great confederation of the United States is of all countries the one whose siderurgical industry is to-day developing most rapidly. Its wealth in coal and iron-ores seems almost inexhaustible. In the last ten years the production of cast-iron has tripled, and that of rails has increased even more rapidly. According to the report of the National Association of Iron Manufacturers, the United States produced—

	Cast iron.	Iron rails.
In 1862	787,662 tons.	213,912 tons.
In 1872	2,250,000 tons.	750,000 tons.

The total production of malleable iron in rails and bars was, besides, in 1872, 1,602,000 tons. During the two years of 1872 and 1873 alone, they set up 83 new blast-furnaces. Of the total production of cast iron, half came from furnaces fed with anthracite, and 479,000 tons from charcoal furnaces.

The use of the Bessemer process is rapidly extending. Ten establishments are already in operation; 125,000 tons of cast iron were refined by this process in 1872. There were produced from it 90,000 tons of rails, which must be added to the 750,000 tons of sundry products. Besides this, they made in crucibles and in Martin furnaces 30,000 tons of so-called cast-steel.

American production keeps pace with the rapidly-increasing consumption, while the importation decreases year by year. Thus, in 1871, they imported 510,000 tons of rails, while in 1872 the number was reduced to 477,000 tons, 133,000 of which were Bessemer rails.

According to this report, it will not be long before the United States will be able to supply itself. Pure iron-ores are, meantime, at a relatively high price. The district of Lake Superior furnished, in the single year of 1870, 985,521 tons of mineral wealth, valued at the mines at 21,000,000 of francs. The net cost of the celebrated Marquette ore is 14 francs, without interest on the capital.* This circumstance explains

* Iron and Steel Institute, 1873, No. 1, p. 223.

the strange fact that the Americans, in 1872, came as far as Algeria to buy a certain quantity of pure ore.*

We will add that the mineral wealth of North America is, in part, used directly for malleable iron at bloomeries. The Catalan forges produced, in 1872, 52,000 tons of iron; but this manufacture is yearly diminishing, giving place to the blast-furnace and to the Bessemer process.

The American exhibition contained some rare collections of minerals, of fuel, and of metallurgical products, of which we need not speak here, since they will give but a very imperfect idea of the great mineral wealth of this vast country.

I prefer to mention the exhibits of Wm. Sellers & Company, of Philadelphia, (No. 454 of Group XIII.) They consisted of a revolving puddling-furnace, of a universal rolling-mill, of a drop-hammer, &c.

148. The puddling-furnace consists, like that of Danks, of a cast-iron egg-shaped vessel, truncated on both ends, and turning upon a large horizontal shaft. But at the bottom it resembles the revolving-furnace of M. Siemens, more than the so-called Danks furnace. This one has one end truncated; this is open, and serves at the same time for a working door, and for a passage for the entrance of the flame. It is set against the furnace, which consists of a gas-generator, and a brick structure which has some resemblance to the regenerator of the Ponsard system, for the heating of air for combustion. The gas and the warm air arrive by two opposite channels, and, igniting, enter the furnace a little above its axis; then, after passing through a vertical horseshoe-shaped path, escape by a similar opening placed under the entrance orifice, going from thence to the regenerator to heat the air. This arrangement differs from the horseshoe system of M. Siemens only in the relative positions of the two passages. In the Siemens furnace they are placed one beside the other in the same horizontal plane; in the Sellers furnace one is above the other, in the same vertical plane. In both systems, one might fear that the flame might escape directly by the outlet, without going through the entire course of the horseshoe to the end of the furnace. Really, there is no danger of this taking place. The flame arrives at the entrance with a horizontal velocity great enough to drive it the whole length of the furnace.

The Sellers furnace is set with its motive machinery on a horizontal plate, provided with rollers on its under surface. The little engine can turn the system horizontally 90° around one of its edges. The furnace is thus turned from its normal position; the machine is then recharged. At this moment the current of gas and that of air are cut off. This arrangement of a single opening tends to reduce the waste of heat, but at the bottom it is more inconvenient and less commodious than as in the Siemens furnace. In the latter the two truncated ends of the vessel are open, one for the entrance of the flame, the other its exit. This latter orifice is furnished with a fastening, movable, balanced, and slid-

* Purchased as a commercial experiment.—Ed.

ing, like that of ordinary puddling-furnaces. With this arrangement, the workman can interpose at will with his tool at any time during the whole operation, if he considers it necessary.

The interior of the revolving-furnace is lined almost like the Danks furnace, and is cooled outside by water.

The first coating directly applied to the interior of the casting is composed of—

Rich pulverized iron-ore	100 parts
Hydraulic cement	12 parts
Silica	18 parts

It is given a thickness of five centimeters, and dried and heated to a cherry-red. They also melt the cinder and imbed blocks of ore in it, being careful to equalize the surface with powdered slag heated equally nearly to fusion.

The charge for one operation is weighed at the cupola, and run melted into the furnace. They work over 300 kilograms in an apparatus whose interior measures nearly 1.50 meters in length, and from 80 centimeters to 1 meter in diameter at the largest part.

The charge being introduced, they revolve the furnace at the rate of eight turns a minute, and when the iron begins to melt they tap the scoria, and reduce the speed for five minutes to two revolutions per minute at most, for the formation of the ball.

A certain number of these furnaces are working in America, and I am assured that they give satisfactory results. At all events, I thought it would be well to mention this new attempt at mechanical puddling.

The rolls placed beside the furnace present two peculiarities. In order to facilitate the exchange and adjustment of the rolls the frames are fitted to a rack. A pair of pinions fixed on the base of the frame permit it to be easily moved along the supports serving as slides. A few turns of the handle suffice to accomplish this.

The apparatus itself is a kind of reversible universal rolling for plate-iron. The upper roll is perfectly balanced. Instead of simple adjusting-screws, they adjust the rolls by the aid of two hydraulic pistons. The grooves are deep, so that for a certain width of bar one groove suffices. They simply depress the upper roll some millimeters after each passage, as for the rolling of large plates.

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MINES.

Report of M. E. Petitgand.

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149. Great Britain and the United States, the latter with its vast mineral wealth hardly touched as yet, the former with the potency of its tools, displayed nothing like the show and profusion at Vienna which distinguished them at the exhibition on the Champ de Mars. It may be that the distance from Vienna, and the nearness as to time of these exhibitions have deterred some, while others have been kept back by the great expenses involved.

GROUP II.

AGRICULTURE.

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THE UNITED STATES OF NORTH AMERICA.

REPORT OF M. EUGENE TISSERAND.

150. If we were to judge of the agricultural importance of a country by the area appropriated to it in the inclosure of the Exhibition park, we should make a great mistake.

The United States of America have a territory as large as the European continent, 1,000,000,000 hectares. A surface of 200,000,000 hectares is covered by farms, of which 110,000,000 are cultivated.*

The farms represent a value of 46,000,000,000 of francs. The agricultural implements are estimated at a value of 1,685,000,000 francs, the value of the live-stock rises to the enormous number of 7,625,000,000 francs, and this, with the agricultural production, amounts to more than 10,000,000,000 per annum.

This country, which at the beginning of this century contained only 5,000,000 inhabitants, has to-day more than 40,000,000. In 1870 it produced 600,000,000 hectoliters of grains, 1,000,000,000 kilograms of cotton, and 150,000,000 kilograms of tobacco.

The United States, which exhibit to the world the example of a development unparalled in the history of society, occupied a comparatively limited space in the International Exhibition. The area covered by their exhibits of every kind was less than that occupied by the Belgian exhibition; it scarcely equalled that of the Swiss, and was much inferior to that of the English, German, Austrian, French, or Russian. The Turks and Italians had each twice as much space allotted to their raw materials and staple manufactures.

In the palace of industry the United States had 1,385 square meters, including walks, and 1,250 square meters in the great machinery hall. Finally their agricultural machines occupy scarcely 100 square meters in the oriental pavilion of agriculture. There are, in all, 2,708 square meters or 1 meter to 300,000 hectares of area. This should create no surprise. The people of the United States are essentially practical; they are never satisfied with words or useless demonstrations; small gratifications of self-love count for little with them, show does not affect them. A thing is of importance to them only when it will be likely to be of immediate or early use to them, and to bring in some return. Hence their exhibition contrasted singularly with those of many other countries,

* Statistics of 1870.

which incumbered their galleries with collections of curious objects in nature and art, with relics or treasures more or less rare or valuable, objects which simply excite the admiration of visitors.

All that was to be seen in the American exhibition had on the contrary a clearly-defined object; nothing was found there which did not yield a return. There were exhibited machines and raw materials which are extensively used in trade, or which are susceptible of becoming important for exportation. There might be found all that could strike the imagination of visitors favorably, and by creating the desire to settle in the midst of a region which produces them in such marvelous abundance, maintain or increase that formidable current of emigrants which carries away regularly each year, from old Europe, a portion of its youth and of its living forces.*

Such being the case, these magnificent bales of cotton piled like a trophy at the head of the American gallery; this splendid shrubbery covered with silken capsules, as if snow-flakes were condensed there; this rich collection of tobacco from Kentucky; the exhibition of agricultural products, fruits, and vegetables, made by the great Pacific Railroad Company, which has so much land to sell and to colonize; the exhibitions by the governments of the States, the towns, and the rural villages, which by showing the immense resources consecrated by the country to the education of children and adults—all these offer new inducements and encouragements to emigration.

Samples of salts, of ores, of marble, of coal, of schist, of petroleum, photographs showing the richness of the country in mines, and even the picturesqueness and splendor of nature in the mountains—nothing is wanting to allure visitors and entice them toward these countries as toward an unexampled Eldorado; so much for colonization.

In the shed which protects the machinery we found little aside from a large collection of sewing-machines, reapers, and mowers; that is, the instruments that the Americans manufacture on a vast scale, and which are the object of a large commerce to them. Of drills, ploughs, and hoes we saw but a small number there, the manufacturers knowing well that they are not in a condition to compete for these articles with the European manufacturers.

They exhibited, on the other hand, quantities of machines for cutting grass, and beautiful collections of steel tools, such as shovels, forks, scythes, and rakes, of remarkable lightness and durability; these are always articles of exportation. Except what will promote colonization

*From 1820 to 1870 the total number of emigrants who came to the United States was 7,500,000, representing a value of 42,000,000,000 francs of that capital most precious to a state, that is human capital. The number of emigrants from France was 255,000, from the British Isles 3,857,000, and from Germany 2,367,000. At every revolution, or great unexpected crisis in Europe, there is a corresponding increase in emigration to the United States. Thus the events of 1870 were favorable to the United States. The European emigration was in 1871, 1,000 persons per day. In 1872 this number had increased to 449,030 individuals.

or commerce they have nothing. There were only 40 exhibitors of agricultural products; of machines of all kinds there were 150 exhibits, of which 30 were agricultural implements.

151. The principal products exhibited by the United States were cereals from one part, and from the other cotton, tobacco, hemp, and a certain quantity of products of animal origin.

Among the cereals exhibited we ought to mention particularly the beautiful specimens of the great Pacific Railroad Company. The grains almost all belonged to the varieties of tender wheat and of light color; the red grains were in the minority.

A white variety of winter-wheat was especially remarkable: the weight was 78 kilograms to the hectoliter. The Pacific Railroad Company only exhibited wheat in sacks. They took care to put with them beautiful sheaves showing the quality and great size of the straw of each variety. We saw here sheaves of wheat (touzelle) of the height of 1.70 meters, sheaves of white oats of 1.70 meters to 2.00 meters, bundles of clover and of timothy of 1.20 meters in height. The barleys exposed were also very beautiful, and belonged to the chevalier variety.

A magnificent collection of maize in the ear and in the grain, specimens of broom as beautiful as those which are cultivated in Algeria and in Spain, specimens of fruits, and drawings of vegetables of all sorts, completed this interesting collection.

Oregon also exhibited beautiful cereals, among which should be mentioned the winter-wheat called mammoth white wheat, which is very delicate and tender and furnishes a choice flour, the mammoth spring wheat, with grain larger and smaller, the golden amber, winter variety, grain larger on the average, of a pale color, white, and translucent; the winter touzelle yellow and large-grained.

We should describe also, among other cereals exhibited by the United States, a variety of white spring-wheat, small ovoid grains pointed at their two extremities, hard to the teeth, and known by the name of white club wheat. This wheat comes from the country of the Mormons, which has been cultivated for ten years; it is at a little distance from Salt Lake, Utah; it exhibits qualities which make it preferable in those remote countries to all other varieties. It has the quality, they assure me, of resisting the greatest drought. It grows well even in those countries where it hardly ever rains, giving the high production of 40 hectoliters per hectare, and a weight of 85 kilograms per hectoliter. Though some exaggeration cannot be avoided in these statements, this wheat does not the less merit our attention. It seems desirable that the experiment should be made in those parts of France most subject to great drought, and in Algeria especially. Should this variety realize but the half of the advantages attributed to it by the American commissioners, its propagation would still be important in the south, and especially for our colonies.

The Rocky Mountain spring-wheat has similar qualities and charac-

teristics. It is recommended for stony soils. It is also a small-grained wheat, very hard and very heavy. The weight per hectoliter exceeds 85 kilograms if the sample is farily representative of it. The exhibition of corn, as in the Exhibition of 1867, presented at Vienna a great many different varieties. It is the plant *par excellence* for American culture. This is also the grain of all others which gives the largest return to the United States in the actual conditions of culture. Thus, while wheat can with difficulty be made to produce from 12 to 13 hectoliters per hectare, it is not rare for corn to produce 35 and even 40. The general average of produce is 25 hectoliters to the hectare. The varieties of corn cultivated in the United States are also increasing very rapidly. There could be seen on the shelves of the American exhibition ears of all sizes and of all colors, having grains of all shapes and all sizes, from the pearled maize to the great maize of Illinois and Nicaragua. Southern Europe, however, has nothing to envy the United States according to this report.

152. The numerous specimens of tobacco exhibited at Vienna show the importance that the Americans attach to this culture. It is said that this plant, by furnishing capital to the first colonies established on the Alleghany slopes, was to the United States the first, and one of the most powerful means of development. Virginia, Ohio, Louisiana, Missouri, and Kentucky exhibited some very beautiful leaves from the harvest of 1871 and 1872. When one thinks of the immense resources which the United States received in the beginning in the profits of this culture one cannot but regret to see our Algerian colony, especially suited to this culture, producing so little of it. Algeria—one cannot repeat it too often—would profit more by the extension of this culture than by all other encouragement. By this the colonies would gain what they most need, capital; and there is nothing which so accelerates the growth of a colony as the prosperity of its first inhabitants. This is an irresistible magnet. At one time, however, the culture of tobacco was carried on in Algeria; the colonists were amassing capital; it was remarked immediately that home-labor was more active. Unfortunately the difficulties, the occasional exigencies, caused by the poor quality of the products presented, discouraged the Algerian planters, reduced almost to nothing the area devoted to this culture, and, to the detriment of colonization, retarded the progress that had begun. Meanwhile the example of the United States should neither be forgotten nor lost; the result is worth some consideration, some sacrifices, especially in the beginning. We should never forget that money gained by agricultural labor is worth more than money given or expended in premiums or in building houses. It is worth more than gold found in the ground, as the history of Spanish America proves.

153. The United States disregard what they owe to the culture of tobacco; but it is to cotton, to king cotton, to *God* cotton, that they render honor; so its place was a marked one in the Exhibition. At the

head of the galleries occupied by American products might be seen a cotton-plant covered with hundreds of full-blown seed-pods. It was there the emblem of the wealth and power which it gives to the country; behind, they set up like a trophy a pile of cotton-bales from Louisiana and Georgia. The long-staple cotton of this latter country at once attracts attention by its fineness, its elasticity, and the silky look of its fibers. Of all the States, Louisiana made the most beautiful exhibition of this product. An exhibitor from New Orleans presented an interesting collection of cotton-plants grown in different soils, and from different seed, with capsules closed and open, showing the condition of the textile material in all stages of its growth. Missouri and Texas also exhibited some beautiful specimens. The cotton-cultivation is always cantonned on both sides of the lower part of the Mississippi and on the eastern part of the portion south of the Alleghany Chain, in Alabama, Georgia, and the Carolinas. It does not extend beyond this.

Besides these productions, which form the basis of the American exhibition, there were only specimens of hemp, flax, vegetable hair (moss) picked from the branches of a tree in Louisiana, with sugar-canes, specimens of guano and of powdered bone, which present no peculiarities worthy of special notice.

154. Some bottles of wine, adorned with labels more or less imposing, attracted attention. Imitations of Champagne wine were especially abundant, under the names of "Sparkling Catawba" wines, "Sparkling Imperial," "Sparkling Golden Seal," "Pearl of California," and even "Matchless Sparkling." These products, mostly from Ohio, California, and Missouri, do not nearly equal our wines, but one can see in them what American perseverance will finally make a success.

The United States produce to-day 117,000 hectoliters of wine. This is certainly very little in comparison with the amount consumed there; and though progress is rapid in these countries, it is probable that North America will long come to us for fine wines. The importations of that country, in spite of excessive duties, amount to upward of 40,000,000 francs per annum.

155 Several exhibitors from Louisiana presented very beautiful specimens of ramié, (*Urtica nivea.*) Dr. Collier, of New Orleans, had a little case in which could be seen very beautiful specimens of harl and tissue of this plant. Though this exhibitor advocates the culture as a means of arresting epidemics, yet in enriching industry with a new textile material this vegetable, it is said, amounts to very little. The warm region in the middle of the United States is suitable for it, but there it finds itself in the presence of king cotton, which naturally remains the favorite plant of American agriculturists.

156. The exhibition of California deserves special mention, for besides magnificent cereals, numerous specimens of wine, fruits, and minerals, it included also beautiful specimens of cotton and silk. This country, by its character, its climate, and all its natural resources, seems to be, of

all the States of the Union, the most likely to imitate our agriculture and raise productions similar to our own.

The only animal food of importance which the United States exhibited consisted of lard, smoked meat, hams, and whole carcasses of smoked pork. These productions, the commerce in which daily increases in Europe, were very largely represented in the Exhibition at Vienna.

The production of wool seems to receive but little attention in the United States. Very few fleeces were exhibited. The attention of agriculturists in that country is evidently not given to this subject.

Beet-root sugar seems in a fair way to gain a foot-hold in the United States, principally in California and the West, but thus far all efforts have failed.*

157. The American implements were remarkable for beauty and finish. All were fashioned, put together, and polished like clock-work.

The steel hand-implements, such as forks, scythes, shovels, and spades, are well known. It has been seen in former exhibitions that they are at once light, flexible, and durable. Without insisting in this article that it would be desirable to see cotton plows and hoes manufactured more extensively in France, we cannot fail to mention the exhibition of Messrs. Follows & Bate, and that of M. Remington, whose works use steam to the amount of 150 horse-power, and manufacture a great quantity of them. The jury of Group II recognized the value of the productions of this house, by according to it honorable mention.

The house of Furst & Bradley, of Chicago, is considered superior in this manufacture, in the quality of the work, and in the durability of the plows; some are all of iron, with the beam bent round like the neck of a swan; others having the beam and handles of wood with the mold-board of cast iron or steel. This house sells in America mostly the so-called American plow, in which the coulter is replaced by a cutting-edge.

Among other exhibitors of plows we should mention the house of Deere & Co., whose great establishment is situated at Moline, Ill.; Messrs. Collins & Co., of Hartford, whose plows of steelified iron have already been given an award at the Universal Exposition at Paris, in 1867. Their double-share plow, all of iron, made with extreme care, is a model of good workmanship and fine finish, but its very high price, 400 francs, does not allow of its being compared with our "*polysocs*," which, while not as well made, nevertheless accomplish the same object.

The hoe of Messrs. Marsh & Co., of Sycamore, Ill., No. 386, presents an improvement which should attract the attention of our builders. Each share is furnished with a sheet-iron blade, supported by the frame of the instrument. These blades, which are vertical and have

* The United States produced, in 1870, 2,000,000 kilograms of sugar-cane and 13,000,000 of maple sugar. They imported during the same time foreign sugar to the value of 400,000,000 francs.

their plane parallel to the axis of the hoe, in the line of traction, enter the soil on each side of the row of plants, and so give more fixity to the machine during its progress. They serve to guide it and to prevent it from turning to the right or left, thus protecting the rows of plants.

This method, however, is not wholly new; it has been used already for several years, and has given, among others, excellent results in the beautiful and extensive farm of Baron Horsky, at Kolin, Bohemia. It could evidently be adapted to the hoes which we use for beets.

The farmers of the United States are accustomed to sow seed in drills. Experience has proved, in fact, that in the great plains of the Middle and of the Western States, where cereals are grown on so vast a scale, sowing in rows insures better gathering; the plants sown in drills root more firmly, and better resist cold, tempests, and particularly those violent winds which injure the harvest by drying up the soil. Besides economy in sowing, this distribution always insures a large production of grain; the wheat is better nourished and is of better quality. These results are easily understood; the grains being deposited uniformly, at just the proper depth, the germination is regular; the roots develop uniformly and penetrate farther into the soil. Consequently they are more sheltered from the cold, and from the scorching summer winds; the plants shoot forth more vigorously and steadily. These advantages, mentioned in all the agricultural reports of the United States, are to-day well known to American planters. Thus, during these latter years, the manufacture of seeding-machines has attained considerable importance in this country. Those which they have constructed are, for the most part, imitations of English machines, and as their makers have no chance of competing in this respect with European manufacturers, the exhibition of the United States contains but a single example, that of Messrs. Thomas Ludlow & Rodgers, of Springfield, Ohio.

The American horse-rakes were represented by two specimens, which have nothing new in their construction. These are all light machines, with long and very flexible teeth, supported by two very slender wheels of large diameter, with which attendants at these exhibitions have been familiar for several years. It is sufficient to call these to mind. The rake exhibited by the Wheeler, Melick Company obtained a medal of merit. Its price in the United States is 150 francs.

The rake of Messrs. West exhibited an excellent method of attachment; the steel wire forming the tooth is simply wound round the wooden arbor which supports it and increases its elasticity. The price of this machine, which secured a medal of merit for the exhibitor, is $40, (200 francs.) It is a very good construction, but rather expensive.

We notice also, among the machines exhibited, the pulverizing harrow of Nishwitz, which is much esteemed by American cultivators, for dividing and pulverizing the earth. Instead of burying the refuse, such as stubble and straw, or bringing it to the surface like ordinary harrows, when they are long, the machine of Nishwitz divides, cuts, chops these

substances, mixes them with the soil, and thus better insures the cleaning of the field by the destruction of vegetable parasites, and insures the action of the compost by mixing it more thoroughly with the earth; it has also the advantage of destroying the field-mouse. It has the form and appearance of a triangular harrow, only, instead of teeth, it has iron cutting-disks of 20 centimeters radius, which can turn about their axis. A seat is placed above the frame for the driver. The weight of the machine is 90 kilograms; its price, with eleven disks at the apex of the triangle, and five at either side, and with a seat upon springs, is 150 francs. It is manufactured by the New York Plow Company.*

We should mention, too, the leather gauntlet, armed with points or teeth, for husking corn, and the lawn-mowers. An important company, Hill Archimedean Lawn-Mower Company, of Hartford, Conn., manufacture these last-named machines on a very large scale. They were invented by Hill in 1835 under the name of Archimedean mowers. This manufactory sells 500,000 francs' worth of them per year. These little machines, which are so generally used throughout the United States, are of four sizes: the machine of 25 centimeters, suitable for a child, which sells for 100 francs; that of 30 centimeters, which a woman can use, at 110 francs; that of 35 centimeters, for the use of men, at 125 francs; and that of 70 centimeters, for a horse, at 500 francs. The improvements, by which its durability and power are increased, while at the same time it is more easily worked, secured to the exhibitors a medal of progress. Let us note, however, at this time, that the house of Follows & Bates, of Manchester, England, produces mowers of about the same quality at a little lower price.

158. The principal feature of the agricultural exhibition of the United States, which attracts the most attention and calls forth the admiration of visitors, is the mowing and reaping machines. We will not, at this time, give the oft-repeated history of this magnificent invention. It is sufficient to say that the number of reapers and mowers manufactured in America is estimated at 1,500,000; that these machines represent a market-value of nearly 1,000,000,000 francs. The number of these machines actually in use in the United States does not fall far short of 1,000,000. It is estimated in America that one machine does the work of seven men, and that the cost of horses, the interest on cost-price, and the expense of repairs, scarcely equal the wages of four men. It follows that the machine saves the three men's wages. Allowing this and estimating at 8 francs only, which is rather under than over, a day-laborer's wages, the United States saves by the use of mowers and reapers 24,000,000 francs per day. The mowing of the prairies and harvesting of cereals lasting, on an average, sixty days in America, the annual saving would be 1,440 millions francs, or 14,500 millions in ten years. Add to this enormous sum the advantages which result from the rapid cuttings

* New York Plow Company, of Newark, N. J.

of the cereals at the proper time, the grain saved, and the profit on the labor of three million men, thus left at liberty to engage in other branches of industry. But, setting aside these advantages, the mowers and reapers, even if it costs more to use them, are of inestimable service to the United States, since without them the cultivators would be utterly unable to find hands to gather the 100,000,000 hectoliters of wheat which they raise, part of which is brought to us when our harvests fail. From all this it is easy to see the importance of the machines to the United States. The inventors *love* their machines, and their wits are continually at work to improve them; hence the unequaled finish, elegance, and exquisite work employed in their construction. The machines exhibited in their hall, especially their models, are perfect gems, wrought and polished with true artistic taste.

The leading feature in this exhibition is the tendency in the United States to make combined machines, that is, machines for two purposes; to mow natural and artificial prairies, and also to gather the cereals by means of certain simple arrangements of the machine. It is the other way with those designed in Europe. American cultivators prefer one and the same machine to mow their prairies and cut their cereals, preferring to wear it out sooner and renew it more frequently. They have facilities for this which we have not. The perfection of the work is of small importance to them. What they want is to save their grain; they care nothing about the straw. On the other hand, in buying but a single machine, the American cultivators employ less money. Now, capital is very important to them. Besides, it should be remembered that in the United States small farmers abound, and that these farmers can assist each other but little in their work, because they are always in the cereal region, very far distant from one another. There are, according to the official statistics published in 1871, more than 2,000,000 farms that have less than 40 hectares, namely:

	Farms.
From 1^{h}.21 to 4^{h}.04, (3 to 10 acres)	172,000
From 4^{h}.04 to 8^{h}.09, (10 to 20 acres)	294,600
From 8^{h}.09 to 20^{h}.23, (20 to 50 acres)	847,600
From 20^{h}.23 to 40^{h}.46, (50 to 100 acres)	754,200
From 40^{h}.46 to 202^{h}.30, (100 to 500 acres)	565,000
Less than 20,000 farms have more than 200 hectares.	
From 302^{h}.30 to 404^{h}.60, (500 to 1,000 acres)	15,873
From 404^{h} and above, (above 1,000 acres)	3,720
Total	2,659,985

Under these circumstances* and in consequence of the scarcity of cap-

* It is noticeable that the tendency is more and more toward small farms; thus the greatest average extent of the farms was 153 acres (61^{h} 90^{a}) in 1870, according to the numbers above given. In 1860 the number of farms was 2,044,000, with an increased average of 80 hectares 52 ares 45 centiares per farm. In 1850 it was 1,449,000, with an increased average of 82 hectares 13 ares 88 centiares per farm.

tal, the cultivators are obliged to use combined machines. The difficulty to overcome in order to make good combined machines is to so arrange the parts of the machine that the cutters in both cases may work with just sufficient rapidity to cut both grass and cereals. Now, these operations require different speeds. On account of the sap which they contain, the grasses require a quicker movement of the blades than the dry stalks of wheat or oats. If the blades move fast enough for the cereals they do not cut the grass well; the blades become choked, and the sap lubricates them and makes it necessary to stop often. With the speed suitable for mowing the prairies, there is, in cutting cereals, the breaking of the straw and harder labor.

The sagacity of American inventors is employed in endeavoring to overcome this difficulty, and it is said that while they have not attained the perfection of the simple mower and reaper, they have produced combined machines which for execution of work approach good mowers and the best simple reapers. Consequently, mowers and reapers are divided into three distinct classes, thus:

1. Mowers.
2. Reapers.
3. Machines used for mowing meadows and for cutting cereals.

These two latter classes form each two classes: (1.) The reapers forming the sheaf mechanically; (2.) Those which do not make the sheaf, but leave the harvest in swaths behind the machine. Those of this last division are becoming more rare. They are represented by but a single specimen, the combined machine of Sieberling, of Akron, Ohio, known as the Excelsior. It does, in fact, only a part of the work, and it must be followed by men to gather up, form, and bind the sheaves, which increases the labor of harvesting. This class of machines was more common in the early days of this invention, (type, Hussey,) but the problem was not fully solved. Next, a machine was demanded to throw the swath to one side; then it was required to lay the harvest in regular heaps ready to bind.

159. The inventive genius of the Americans did not stop here. We find it pursuing another idea—that of making the machine bind the sheaf, and dispensing with the hand-labor of gathering the bundle and binding it. Mr. Walter A. Wood, whose name is associated with the invention of one of the most perfect mowers, presented a machine by the use of which, with the assistance of his associate, Mr. J. D. Locke, he has endeavored to solve this problem. In Mr. Wood's machine, the cereals are cut, as in ordinary machines, by the use of a blade armed with saw-teeth and moved with the required celerity, but the fixed table which receives the cut plants is replaced here by an endless cloth carried at its two extremities on rollers. The cut grain is carried by the cloth to the edge of an inclined plane, on which moves an apron covered with points. This apron is composed of strips, with spaces several centimeters wide between them, and is fastened upon leather straps which

turn over the ends of the inclined plane. It moves from below upward, like the endless cloth; the grains are seized by the projecting points of the apron and carried to the top of the inclined plane, whence they fall down on to a concave surface, which forms the table of the binder machine; an iron wire rolled on a bobbin placed behind this table is unrolled by the machine; the two arms of the apparatus come together, gathering the heap of grain as a binder would do; a little clock-work movement twists and cuts the wire. The sheaf is formed and bound; it is detached by its own weight and thrown out on to the ground; the wire is again unrolled, a new heap of grain bound and thrown out in sheaves behind the machine, and so on.

Wood's binding apparatus is still in its infancy; the inventor does not wish to try it in the field, but is satisfied with showing its method of working, by making it bind up a bundle of newspaper; he acknowledges that it is not now in a working condition; he wanted to show the principle of a discovery which he proposes to continue to perfect till he can make a practical application of it. They have evidently an idea, and certainly the people who invented the sewing-machine will not be compelled to work long in order to practically settle the difficulties of the mechanical binding of the sheaves.

This invention would certainly be very valuable at this time when the scarcity of hand-labor is more and more strongly felt, but it cannot be denied that it will make the mechanism of the reaper much more complicated, and will require an exertion of power, perhaps for our countries, out of proportion to the cost of the binding by hand.

160. The American machines were subjected to a practical competition, which took place July 9, at the farm of M. Schwartz at Léopoldsdorf. The reapers were each assigned a lot of sixty-one acres of rye. The mowers, unable to work under normal conditions for want of natural or artificial meadows, were made to work in a field of *vesces*, the gathering of which offered no difficulty. The piece of rye to gather was itself very uniform; the weight of grain was medium, and it was nowhere beaten down.

Nineteen reapers and sixteen mowers, all American, the English, French, and Germans not thinking it expedient to take part, were admitted to this trial, which took place on one of the warmest and most fatiguing days of the season, in Vienna. It was said that all the machines worked well. The lots were cut satisfactorily in less than an hour and twenty minutes of actual work. The machines were driven by the Americans with their usual *sang-froid* and high spirits.

It was evident that the problem of cutting grass and grain has been solved. More or less of the perfection of the work depends on the ability of the driver, and on the docility, strength, and regular pace of the horses. Thus, the time has come for agricultural associations to add to their usual competitions in husbandry, the practical trial of mowers and harvesters, the management of which requires, on the part of the driver, much attention, watchfulness, and rapidity of movement.

In the experiments of Léopoldsdorf, the mower of Mr. Wood presented marked superiority. It is impossible to move more regularly or easily, to cut the grass more smoothly, or to clean the ground better. The work, according to the unanimous decision of the jury and of the numerous spectators at these experiments, was adjudged perfect, leaving nothing to desire.

Mr. Walter Wood's mower is too well known in France to require description here. It appeared with the same success at the Universal Exposition of 1867, where it gained for its inventor a grand prize and the decoration of the Legion of Honor. Mr. Walter Wood is an ardent aspirant. He will not rest on his laurels. We have already noticed his attempts to produce a harvester with binder.

His double-acting harvester was also operated in the field of Léopoldsdorf. Although it did not equal the perfect working of the mower, it yet performed the work assigned to it very creditably. His reaper, called the Champion, cut the rye in its lot very nicely, and worked very regularly. Out of an hour and fifty minutes, during which it was employed on the work, it only stopped twelve minutes for lubrication. The depositing of the sheaf was not quite all that was desired. Its price is $130 (650 francs) at New York. It combined great simplicity of construction and durability, with relatively light weight.

The establishment of Mr. Walter A. Wood, at Hoosick Falls, N. Y., commenced in 1853 the manufacture of mowing-machines. Beginning in a small way, the manufacture soon began to increase largely; in 1862 it had attained the number of 6,425 mowers manufactured per year. The war of secession retarded its progress, but the labor-market soon resumed its activity, and each year since 1864 its sales have increased. In 1869 they turned out 23,000 machines; to-day they make 6 per hour, or 57 per day. The whole number of mowers manufactured by the Hoosick Falls Works (from 1855 to January 1, 1873) was 160,648. The machines, on the same principle, made by other houses licensed by Mr. Wood have been about 20,000 in number, which makes 180,648 mowers on this plan sold in less than twenty years. Of this number, about 30,000 have crossed the Atlantic, and have been delivered in Europe that is, 25 per cent. of the whole number of American mowers manufactured have been sent to the Old World. The total manufacture of the Walter Wood mowers represents a value of at least 100,000,000 of francs, and the use of them has saved to agriculture the value of 1,000,000,000 francs of hand-labor. Looking at the subject in this light, Mr. Wood has been a benefactor to humanity and deserves the Diploma of Honor.

161. The combined machine called the Champion, exhibited by Messrs. Warder, Mitchell & Co., of Springfield, Ohio, has solved, as fully as can be desired, the problem of the production of a machine that can mow meadows and gather grain. Transformed in a few minutes into a reaper, it works very satisfactorily. This machine is well made. Its

frame of wrought iron insures durability and stability; the axes and driving-wheels are fastened with care. Reduced to its simple elements it consists of a small number of gears. It rests on two cast-iron wheels of $0^m.77$ diameter; each of these two wheels carries $0^m.20$ inside the exterior face of its rim, a gear, whose inner radius is $0^m.20$; the number of teeth is 82; these communicate the movement to a pinion $0^m.11$ diameter, having eleven teeth. The shaft of this pinion carries at its extremity at the left a bevel-wheel of $0^m.20$ radius, having thirty-five teeth. This shaft carries the clutch serving to couple and uncouple the machine. The bevel-wheel communicates its movement, when the machine is coupled up, to a pinion with twelve teeth and of $0^m.07$ interior diameter. This latter pinion turns a shaft which transmits the motion to the cutting-blade, changing the circular into a reciprocating motion, by means of a crank of $0^m.06$ radius.

The cutting-blade, and the fingers which guide it, are perfectly made, and of excellent steel.

A wooden table or flooring, protects the mechanism; the coupling and uncoupling are easily done. The driver, seated at one side over the wheel of the machine, has under his hand the lever by which he works the coupling. He can raise the blade almost vertically while on the road, and by a spring lever, which works easily, raise or lower the frame with its teeth, in order to cut more or less closely. The movement of the reaper-rakes is regular and automatic. The driver's seat may be a little too far forward, thus obliging the operator to turn his head, to see the obstructions which choke the blades. The transformation of this machine into a mower is very easily made; it is only necessary to take up the reaping apparatus and the table, a movement requiring but a few seconds. This machine is at the same time light, very durable, and it is very perfectly made; the blade $1^m.30$ long. It mowed the lot assigned to it, to a nicety, in one hour and ten minutes, and the sheaf was well made. Unfortunately, it was impossible to make a more complete study of this machine and to estimate the force required to operate it, but from the statements before given we can assert:

1st. That the speed of the blade ($2^m.08$) is greater in Warder's Champion than in ordinary reapers, since the speed of the cutting-blade in the latter is, on an average, $1^m.75$ per second. It is a trifle higher than that of mowers proper, in which the average speed of the blades is 2 meters.

2d. That the number of revolutions of the crank per second (8.69) is noticeably less than that established by Langres's experiments with mowers. According to the latter the number ranged from 11.18 to 15.44; but it is more than in the reapers, which, as given by Grignon, is 5.87 on an average.

3d. That the number of revolutions of the crank to one revolution of the driving-wheel is a number (21.73) intermediate between the number of revolutions of mowers, (24.52,) and that of harvesters, (16.32,) on an average.

It will be seen from this that this harvester combines very nicely the qualities of a mower and a reaper. Its superiority from this point of view was not only proved by the perfectly practical experiments of Léopoldsdorf; it had been acknowledged besides in a great meeting held a few days before in Hungary. It was acknowledged in 1871 in the United States, at Findley, Ohio, and at Columbia, in Tennessee, where this machine, besides doing the work very nicely, had the additional advantage of requiring less draught in the dynamometrical trials than any other combined machine. But it was proved on the other side that the combined machine always requires, as is seen from the preceding considerations, a little greater power for each kind of work than the simple machines.

The combined reaper of Messrs. Warder, Mitchell & Co., was invented in 1856, and has been since so improved as to make it the best machine of its class. It has a great reputation in the United States, and is gaining ground in Germany, Russia, and Austrian-Hungary. It costs $225 in America, (1,125 francs.) According to the statement of the exhibitor, 12,000 of these machines have been sold in the last year, and in 1873 the number amounted to 15,000. Not less than 150,000 Champion mowers and reapers have been sent out from the three great manufactories established at Springfield for working this patent. One can form an idea of the magnitude of these manufactories from knowing the fact that this one of Messrs. Warder, Mitchell & Co. employs 300 workmen and 100 horse-power.

It would certainly be interesting to see this excellent implement introduced in France, where there are so many men of small or moderate means, like the farmers of the New World. The jury awarded to it a Medal of Progress.

162. The combined reaper of Johnston, of Brockport, N. Y., rivals the preceding machine in its workmanship. Like the latter it mowed its lot very easily and rapidly, and the sheaf was equally well made. This machine was distinguished above other combined reapers by the large size of the two wheels which support the whole and communicate its motion to the blade. These wheels are of wrought iron, and $0^{m}.90$ in diameter. Their axis carries a plate $0^{m}.20$ in diameter, with fifty-two teeth which engage a pinion of sixteen teeth. At the end of this pinion-shaft is a bevel-gear with thirty-two teeth; the shaft of this pinion communicates the motion to a second toothed-plate, engaging a third pinion whose shaft gives motion to the crank-disk. The same shaft, by a horizontal wheel, works the reaper-rakes. All these pieces are nicely fitted. They are held firmly in place by an iron frame. The blades move regularly and quickly enough to cut grass and grain. It also works easily, producing a little heavier draught than the Warder machine. The coupling and uncoupling are easily effected by the use of a lever which engages or disengages the first pinion with the driving-wheel. The driver's seat is on the left side, and a little in front of the

machine, serving as a counterpoise to the rakes and blades, distributing the whole weight more equally on the two wheels. For those reasons, when it is worked on a piece of wet ground the wheels do not sink down further on one side than the other; moreover, on account of the diameter of the wheels the bevel-gear cannot touch the ground and become choked with earth or mud.

The reaping-apparatus consists of five arms, one more than in other machines. This addition of a fifth arm makes it easier to pull down the grain, and is especially advantageous when there are heavy winds during the harvest. In Europe four arms are considered enough. The rakes are moved by means of an endless chain which is wrapped about a wheel having projecting teeth, somewhat like the preceding machine. The reaping apparatus, by simply changing a pinion, increases or diminishes the sheaves, so as to make them all of the same size, whatever may be the condition of the harvest. They work as do seed-drills, when it is desirable to vary the quantities of seed to be deposited in the soil.

The movement of the levers in depressing or raising the cutters, according with the irregularities of the ground, is easily made. The length of the finger-bar of the reaper is $1^{m}.27$, and the total weight of the machine, mounted as such, is 500 kilograms. When mounted as a mower they use a finger-bar $1^{m}.27$ in length, which, for transportation, can be turned over upon the draught-pole so as not to project sensibly beyond the wheels.

In addition to the combination machine the Johnston Company also exhibited a simple mower, on the plan of the combination reaper and a simple reaper. The latter appeared at the last Grignon trial. We do not need, therefore, to describe it.

The reaper worked remarkably well at Léopoldsdorf. Its motion was easy, without shock, and almost without noise. It was classed No. 1 for the cutting of rye.

The combination reaper, while it did not work as well, still gave satisfaction. It took but six minutes longer than the simple reaper to accomplish its task. It must be confessed that the movement was not quite so smooth. Mounted as a mower, it was classed below the Wood machine.

The construction of these machines leaves nothing to be desired; the parts are elaborate; the bearings are of bronze; the materials employed are first-class.

This house has also introduced an innovation in manufacture which others should imitate—all the pieces are numbered. This device simplifies the work of mounting, and facilitates the replacing of broken parts, as required.

The Johnston Company is not very old. It dates back but three years; it sells its machines at a comparatively low price, the mower costing 375 francs in America; the reaper, 625 francs, and the combination machine, 775 francs. These different machines won for their exhibitor the

Medal of Progress; they are gaining ground in America. It would be desirable to introduce them into France, in order to create competition among known machines, and a tendency to lower prices.

163. The house of D. M. Osborne & Co., at Auburn, N. Y., presented an excellent reaper and a good mower, which can be easily transformed into a reaper.

The reaper invented by Burdick in 1867, and known by the name of Burdick-Ceres, has been lately introduced into France. It was made known there during the last season.

In Vienna it has maintained the reputation that it acquired in the United States and merited the position of No. 4 in the classing of machines, according to the method adopted at the trials at Léopoldsdorf. While it does not cut so closely or make the sheaf as well as the Johnston, the Warder, or the McCormick, it nevertheless did excellent work; it took one hour and fifty minutes to execute its task, with seven minutes stopping. Its price in America is 1,017 francs. The exhibitor stated that 65,000 have been sold in six years.

The mower manufactured by Osborne & Co. is called the Combined Kirby mower. It is mounted on two wheels and has a frame-work of good cast iron; it has some resmblance to the Champion; the principle is somewhat similar, but the transmission is more direct. There is one less gear.

This mower is very compact, and well planned; it works easily. The driver being placed behind the cutters, can without difficulty superintend their workings, and by the use of a large lever placed within reach of his right hand can raise the cutters to any height, even vertically, drive over obstacles, mow on side-hills, and cut quick-set hedges. This machine worked very well at Léopoldsdorf. It could easily do 50 to 60 ares an hour. Its price is 641 francs at Vienna.

The combined machine (Combined Kirby) is also very simple in its construction. It rests on a single supporting-wheel, whose diameter is $0^{m}.75$, and the width of felly $0^{m}.15$. This wheel carries in its own plane a driving-wheel with seventy-five teeth, which moves a pinion with twelve teeth. The shaft of this pinion carries at its extremity a bevel-wheel with thirty-four teeth, which turns a pinion of eleven teeth. The pinion sets in motion the crank disk and communicates a reciprocating motion to the blade. The space traversed by the blade is $0^{m}.88$ for each revolution of the crank. By the use of these elements it was found that—

1. The number of revolutions of the crank to one revolution of the drive-wheel is 19.31;

2. The speed of the blade is $1^{m}.36$ per second;

3. The number of revolutions of the crank per second is 7.72.

It will be thus seen that the Combined Kirby approaches more nearly the mechanical conditions necessary for a reaper, than those of a mower. Mechanically it realizes less fully the conditions of the combined machine, than does Warder's Champion. It does not mow as well, but it requires less power.

This was the result so far as could be judged from its trial at Léopoldsdorf. The machine mows a swath $1^{m}.40$ in width.

For mounting this machine as a reaper, it is only necessary to attach to the pinion on the axis of the bevel-wheel, the reaping apparatus of the Burdick-Ceres, a pinion and a table. The change can be made in twenty minutes. The machine mounted as a mower weighs 304 kilograms; with the reaper apparatus its weight is 371 kilograms; and its price at the manufactory is $175, say about 920 francs. The Combined Kirby did not work as well as the Burdick reaper; the cut was not as regular, and it was seventeen minutes longer in mowing its lot. Nevertheless, it is an excellent machine, easy to manage, and deserving popularity. It has been famous for a long time in the United States. It is constructed more carefully and from better materials. Perfect workmanship is easily attained when an establishment makes a specialty of the manufacture of an instrument, and possesses the tools necessary for its manufacture. The Osborne works realize these conditions, for in their immense establishment at Auburn, the rapidity of the manufacture is such that a machine can be made in fifteen minutes. They use 200,000 kilograms of iron and cast iron per day and employ 475 workmen. We can judge from this of the working power employed, and the perfection of workmanship, to which they have attained.

Messrs. Osborne & Co. received a medal of progress.

Messrs. Adriance, Platt & Co., of New York, Aultman, Miller & Co., of Akron, Ohio, and the successors of the celebrated McCormick, of Chicago, Ill., obtained medals of merit for the same class of machines.

164. Messrs. Adriance, Platt & Co. exhibited a very beautiful mower, and a mower-reaper on the plan known as the "Buckeye." The Buckeye mower is remarkable for the simplicity and solidity of its construction. Its lightness and extremely easy motion made it popular from its first appearance, which was in 1857. It has a frame of ash, strengthened in the middle by a rib of the same wood. The wooden pieces are very firmly secured by twelve pins. There is much less risk of breakage with this frame, and when an accident does occur nothing is easier than to make the necessary repairs. The frame is mounted on an iron axle of $0^{m}.03$ diameter, and at each side is an iron wheel of $0^{m}.75$ diameter; on the inside of each driving-wheel, near the middle, are fixed two pawls, which by the aid of a steel spring are kept engaged or disengaged. These pawls work ratchet-wheels fastened on the axle of the driving-wheels. By means of one of these pawls on each wheel the system is put in motion as soon as the machine begins to move, the pawls being so adjusted that one is always ready to fall on one of the teeth of the ratchet-wheel. On the axle, and a little to the left, is the principal wheel of the system. This bevel-wheel is placed in a box, to shelter it from the mud and obstructions to which machines whose driving-wheel is uncovered near the ground are exposed. Connecting and disconnecting are easily accomplished; the driver, with a large wooden spring-lever, engages or disengages the pinion which turns the crank.

In regard to construction, there is nothing left to desire in this machine. The crank-shaft turns in bronze bearings; the gears are clean; the blade, when not in use, can be turned down on the draught-pole so as to occupy a horizontal position, which makes it easy to carry it through narrow roads and the bars of inclosures.

The combined Buckeye machine is like the Buckeye mower. The mechanism is the same. Mounted as a mower, it differs from the preceding only in having a longer finger-bar. The finger-bar of the mower is $1^m.225$ long; that of the combined mowers is $1^m.36$. The form of the teeth is the same in both cases.

To make a reaper of this machine the finger-bar is replaced, and a reaper apparatus is attached to the right side of the machine, much like that of Johnston. The blade has more cutters, and is $1^m.51$ longer. The transformation of the mower into a reaper requires but little time; the change can be effected in fifteen minutes. The machine is always easy-working.

From a mechanical point of view the Buckeye mower and reaper much resembles the combined machine invented by Warder, and the combined Kirby. As in these, the blades are longer than in the simple mowers and shorter than those of ordinary reapers. The rapidity of motion is intermediate between that of mowers and that of reapers. It was found, in fact, the length of the finger-bar being $0^m.08$ and the diameter of the driving-wheels $0^m.76$:

1st. That the number of revolutions of the crank for each revolution of the driving-wheel in the combined Buckeye machine is 22.

2d. That the number of revolutions of the crank is 88 per second.

3d. That the speed of the blade is $1^m.41$ per second.

These mechanical conditions insure to this machine as satisfactory a working, both as mower and as reaper, as that of Warder or of Kirby.

The Buckeye machines have a high reputation in the United States; they have always been especially successful in the great American competitions. In the very important trials which took place at Syracuse in 1857, and later at Auburn in 1866, under the auspices of the Agricultural Society of the State of New York, the jury ascertained, by means of the dynamometer, that the Buckeye mower and reaper required less force than any other machine of that class. For the quality of its work, it was classed next below the simple mower of Mr. Wood.

In the fields on the farm of Léopoldsdorf, the Buckeye mower sustained its reputation well, performing excellent work. The combined machine, mounted as a reaper, was not equally successful. It was drawn by a team of horses of average power, and badly trained, as the work plainly showed. The cutting was fairly done, and the binding not so well done; but it was easy to see that these imperfections were attributable to the lack of training of the horses.

The use of the Buckeye machines should be encouraged; they should be well known in France, particularly as their price is low, if one considers their great durability.

The Buckeye mower, weighing 267 kilograms, costs $125, (625 francs.) The combined Buckeye mounted as a mower, weighs 272 kilograms, and as a harvester, 378 kilograms; including blades and reaping apparatus, it costs 850 francs in the United States. These machines are very extensively used in America. They are produced very rapidly, for, according to the declarations of the agent of Adriance, Platt & Co., they do not manufacture less than 20,000 a year. The American works have sold to agriculturists since 1858 about 150,000.

165. Messrs. Aultman, Miller & Co., of Akron, build a similar machine, and manufacture as largely as Messrs. Adriance, Platt & Co. The Buckeye mowers and mowers and reapers, which are made at their works, differ only in some details from those of the latter exhibitors. The frame of the machine is of cast iron, and the saw-teeth are a little longer; as to the mechanism and the work, they are as good; hence the same award was given both.

If the combined machine of Messrs. Aultman, Miller & Co., performed, as a reaper, better work at Léopoldsdorf than that of Adriance, Platt & Co., and completed its task more quickly, the cause was simply, we should repeat, the character of the horses employed in the two cases.

166. The McCormick machine also worked excellently at Léopoldsdorf. There have been, however, no important improvements in this harvester since 1867. Its reaping apparatus is still rather heavy. The jury of the second group of the Universal Exposition at Vienna rendered to McCormick the acknowledgments due to this inventor, and to his services in the cause of agriculture and of humanity, by awarding to his successors a medal of merit for the reapers on his plan, which they exhibited.

167. Aside from the preceding machines there is little to be said. The Sprague machine is well known in France. For want of a representative, it was not carried into the fields of Léopoldsdorf to be compared with its rivals, but remained in a corner in the building where the American machines were exhibited. The combined Excelsior mower of J. F. Sieberling, of Akron, Ohio, worked well. It is conveniently arranged and well put together. The conditions of speed of the different parts were realized sufficiently for good work, but the complaint in regard to it is, that it does not meet the demands of actual agricultural work, not making the sheaf well, and obliging the cultivator to go behind and gather up the swath and make the sheaf. Its price as a mower is 750 francs. The mower-reaper costs 300 francs more.

168. Among the novelties at the exhibition of the United States still to be described, we must mention the replacing of the fixed platform, on which the cut grain falls, by a circular platform adapted to a Buckeye machine, and movable on a vertical axle. This platform raised in the middle in the form of a cap, is about 1 meter in diameter. The swaths falling on this platform are carried away and deposited, without any shock to the machine. There is no important improvement in this.

One inventor devised a way of simplifying the mechanism of mowers and reapers by replacing the two or three pinions and the two or three bevel-wheels, that are found in all other machines, by a driving-wheel working on a worm-gear, whose shaft turns the crank of the cutting-blade. The mechanism is, in this way, considerably simplified.

The mechanism is well made and well protected; the worm-gear is made of cast-steel of first quality, and the toothed wheel of cannon-bronze.

The patenting of this improvement led to the formation of a company for the purpose of working it—the Superior Machine Company, of Wheeling, W. Va. This company makes mowers, mower and reapers, and reapers of this kind. These machines are carefully made, and have bearings of copper. All the pieces of which it consists can be bought separately, according to a fixed tariff of prices.

In the fields of Léopoldsdorf the Superior mower did excellent work. It mowed the lot of green *vesces* apportioned to it very nicely. Its price is very low, only 350 francs in the United States. Its low price and its simple mechanism merit the attention of the agricultural public.

169. To sum up all, if we compare the agricultural exhibition of the United States in 1873 with that of 1867, we find no very marked difference.

At Paris the American exhibition was incontestably more complete, and consequently much larger. The productions were more abundant and the agricultural implements more varied. Beside the mowers and reapers, there were at the Champ de Mars and in the annexe at Brillancourt, specimens of all sorts of agricultural machines, of vehicles, harrows for mellowing the soil, plows, drills, cotton-gins, wheat-thrashing machines, and very interesting collections of steel tools. At the Prater, at Vienna, the exhibition was more limited. It comprised little, as we have seen, besides mowers and reapers; but, on the other hand, this class of machines was represented as it never was before. These useful instruments offer an *ensemble* most complete and satisfactory. Their construction gives evidence of the increasing attention which the manufacturers give to it. They have effected some real improvements in mounting and arrangement of gears. Besides this, machines for two purposes, called combined machines, have been shown in great numbers, and with qualities which insure their practical success. The problem of the cutting of grass and grain is evidently solved now to the satisfaction of agriculturists, and when the improvements in binding the sheaves, which Messrs. Wood & Locke are endeavoring to obtain, shall be practically carried out, there will be nothing left to ask for. The trial of 1873 will not be lost to inventors, and the next Universal Exhibition will doubtless give us the solution of this last part of the problem.

A second fact set forth at the Vienna Exhibition is the enormous development of the manufacture of mowers and reapers in the United States, and the making a specialty of this manufacture by powerful companies, a condition which insures perfection and economy of con-

struction. The American manufacturers have also come to have on the European continent almost the monopoly of the production of these implements, and of their commerce, which has acquired of late very great importance.*

170. In awarding prizes, the predominance of mowers and reapers was evident. All the higher prizes were awarded to the exhibitors of these instruments. Out of sixteen prizes bestowed on American exhibitors in this section, eight were awarded for mowers and reapers, thus: there were one diploma of honor, four medals of progress, and three medals of merit. The other exhibitors had only five medals of merit, and two honorable mentions.

In 1867 the United States obtained for their agricultural implements thirty-nine rewards, two of which were grand prizes; three gold medals, five silver medals, and six bronze medals.

171. The agricultural commodities exhibited at Vienna were the same as in 1867; grain, cotton, tobacco, rice, &c., forming the bulk.

But these specimens themselves have but a secondary importance; they offer no attractions if we see no difference between them and those of 1867; if we remark no apparent progress, they no longer have the same significance. These few bottles of grain, these four or five bales of cotton, these bundles of tobacco-leaves, these carcasses of smoked pork, all assume another aspect to the eyes of him who seeks to determine causes and effects. To him they represent the agricultural productions of the country. It is no longer merely the machine which is working; it is no longer a simple tool, improved with an eye to use in such or such a soil. It is the entirety of agriculture; it is the proceeds, the productive power, and even the institutions of the country, which he is thus led to examine in order truly to understand them.

172. What is the actual American agricultural production? What is its progress? What are the causes which favor it? What instruction can be drawn from it? Such are in fact the multiplied questions which crowd the mind of the attentive observer when he passes before the modest exhibits which occupy so small a place in the midst of the accumulated marvels of human industry.

The development of the United States is of a comparatively recent date. The first pioneers who settled in the New England States appeared in the beginning of the seventeenth century. They settled first on the lesser range of the Alleghanies and beside the ocean. At the same time France began on her part the colonization of Canada. This period was a time of intellectual and political fermentation in Great Britain. The principle of liberty, the rights of man, and especially those of Englishmen, the nature, exercise, and objects of government, were there subjects of general discussion, and many individuals had warmly embraced liberal principles. The Church of England maintained the doctrines of passive obedience and divine right, and the

* The exportation of agricultural machines, which are almost entirely mowers and reapers, exceeded, in 1871, the sum total of 30,000,000 francs.

Puritans in defending their liberty of conscience were forced to attack the temporal power and to defend their civil liberty. These circumstances had driven across the Atlantic a certain number of zealous men, sincere in their convictions, who, feeling the necessity of establishing liberty upon the widest basis, wished to convert the general principles of religious and political liberty which they held in theory, into actual practice by means of liberal institutions. These men, convinced and determined, carried out in their new country their ideas of emancipation and of liberty and the right of representation, in leaving behind them the shackles which the Crown and the Church sought to impose upon their fellows in the mother country, such as feudal servitude, privileged orders, corporations, &c.

They who laid the foundations of the American colony were not, then, merely seekers of gold, adventurers eager for wealth, from the refuse of English society. They were austere men, upheld by a strong civil and religious faith, rigorous Puritans, men much respected and in good social position, and who, tearing themselves away from the pleasures of a large and assured existence, came to secure the triumph of an idea; in obedience to a purely intellectual want, to expose themselves to all the hardships of expatriation. Society seemed to them corrupted and enslaved. They abandoned it, to create a new one according to their own ideas. These men, hardy, laborious, loving true liberty above everything, and knowing how to respect it in their fellows, essentially peaceable, seeking only the triumph of truth and justice, devoted themselves to the culture of the soil, cleared the land, organized themselves and formed a constitution in conformity with their principles.

The first settlements in which they were clustered for worship, and where patriarchal customs with the practice of a severe religion reigned supreme, developed rapidly. Their overflow gave origin to new centers. These in their turn multiplied and formed other colonies. It was like swarms continually leaving the original hive to settle elsewhere, never going very far from the center, nor losing the traditions of early days. The puritan and independent spirit were religiously preserved, and their institutions were modeled, above all, on the political and religious ideas of the early colonists.

The mother country took no care of them; it had other things to do at this period, and self-government became the sole law of these men, accustomed to take counsel only of themselves and of their consciences. One can understand what the new colony would become with such elements, and with men of this stamp.

Very different was the French colony formed in Canada. The time of departure was the same; the population in the seventeenth century was the same; the future seemed even more smiling to the French colony. New France presented, in fact, more advantageous conditions of settlement; the soil was richer, the waters abounded in fish; a magnificent river, the Saint Lawrence, watered it and furnished means of communication with the immense lakes of the interior;

wood and natural productions abounded there; a bay, admirably shaped by nature, rendered it easy of access. Unfortunately, the colonists were not men of the same character, of the same aspirations, or of the same aptitudes as those of New England.

Our colonial history, it must be confessed, is generally mortifying. There are only combats, abuses and errors, enormous expenses, adventurous expeditions, abortive plans, excessive legislation, and the absence of all spirit of independence and of self-government established upon sound basis.

In the metropolis, they fancy that a new country is first settled with worthless people and outcasts, and then made successful by the election of ardent, zealous men as administrators, and planters hardy, industrious, and of unshaken faith.

While England was sending to North America these austere Puritans, who fled from the corruptions of the metropolis, France, at the same period, was yielding to fresh temptations; ignorant, incompetent, and prejudiced ministers gave grants of immense lands and engaged in disastrous financial speculations; monopoly paralyzed all growing industry; they sold especially the right of hunting there. Some capable and faithful governors, like Roberval and Champlain, tried to arrest the evil in the beginning, but their efforts were constantly paralyzed by the metropolitan government, a prey to all sorts of intrigues. A fatal policy forbade the victims of the revocation of the edict of Nantes to find, in some respects, a new country in Canada. The unfortunate fugitives continued to go to our neighbors and increase, by intelligence and experience, their power, and to pave the way for the industrial prosperity and greatness of our enemies.

As to the colonists, they were mostly minors and soldiers who sought the means of making a fortune. They were at heart brave and generous men, but, unhappily, they neglected to clear the soil, preferring the profits and adventures of the chase; they were all fearless hunters. The lakes and dense forests offered no dangers that they dared not brave—even cataracts could not deter them. Always in search of adventure, they were continually at war with the savages, with whom they disputed for game; going everywhere, they even reached the mouth of the Mississippi, but did not establish themselves anywhere, for the few small forts which they built here and there in the wilderness, in the midst and at the mercy of hostile tribes, could not be called establishments. Communities could not be constituted in such an adventurous existence. This was the first mistake; it could be corrected, however, as it was later, by the energetic race that had committed it, when lacking a correct motive at the beginning. But there was another error which reacted disastrously on the future of Canada: while the New England colonies remained forgotten in their corner, governing themselves according to their fancy—thus preparing to maintain themselves victoriously in the day when the mother country should see fit to interfere in their affairs—Canada, after being tyrannized over, over-governed,

nd imposed upon in all sorts of ways, was odiously abandoned and iven up to England. From this time, instead of receiving the benefit f free institutions, of being freed from the trammels which bound it nd from the spirit of legislation which had paralyzed it, the obstacles to ts development were multiplied; it was not only liberty of action which vas denied to it, but it was subjected to all sorts of trials, each seeming iarder than the others. Its new possessors being crazy to check every ;erm of emancipation, for fifty years everything was done to disgust his energetic race, which had now established permanent colonies by subduing the soil and laying down a basis for the sway of French genius.

The parent state even used every means to annihilate this influence, and to exterminate the French families with their religion and their language, and to favor the Saxon element. Vain their efforts, however, and the result proved the vitality of our race, and its fitness for colonization if allowed full sway. French Canada has wearied out its enemies, gained the upper hand, preserved its language and customs, and become a prosperous colony. But, hindered as it was in the beginning and in its early growth, even up to the middle of the present century, it is evident that Canada could not develop as rapidly as the United States. Besides, when the war of independence broke out the English colony had a population of nearly 3,000,000, while the French colony had only 200,000; it took the latter seventy years longer to attain the same result, thanks to excessive legislation. Consequently, in 1776, New England had so substantial an organization that she was able to fight against England and to gain her independence.

After the treaty of Versailles, by which was founded the republic of the United States, the development of this country took a new start, and its power has increased year by year.

173. To-day the United States possess a territory as large as Europe, and a population of 40,000,000! Let us examine more particularly its progress during the last ten years.

In 1860 the population of the United States was 31,000,000; it has gained, then, one-quarter in ten years, or 2.22 per cent. per year. Twenty-two per cent. of the population are farmers.* In France there are 52.71 per cent., (census of 1872.)

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* The total population at or above ten years of age was 28,228,945 in 1870, and included 5,922,471 persons engaged in agricultural professions, to wit:

Farmers and owners of farms	2,977,711
Farm-laborers	2,885,996
Vine-dressers	1,112
Stewards	3,609
Gardeners	31,565
Cattle-drivers	15,369
Dairy-farmers	3,550
Agriculturists	1,085
Those employed in cultivation of rosin	2,478

The progress of cultivation in the last ten years has been still more rapid than the increase of the population. The value of landed property has increased 126 per cent. in the last twenty years. It is actually valued at 100,000,000,000 francs.

In 1850, the area of land in the United States belonging to private holders or public establishments was, in round numbers, 117,500,000 hectares, of which 44,500,000 were cultivated. In 1860, there were 162,800,000 hectares belonging to private holders, and of this number 65,000,000 were cultivated. In 1870, the area of private domains had doubled in consequence of the activity of public sales. It has attained four times the extent of France. The number of hectares improved or rented for cultivation has increased to 75,000,000. Allowing the agricultural population of the United States to be 10,000,000, this gives 7 hectares of land per head. In France it is but 1.5.

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174. As we have already seen, it is the small proprietors that are most numerous in the United States. The administration, in the sales of land, has purposely limited the extent of each lot, in order to prevent the monopolies of land which in other countries ruin colonization. The maximum of land which can be bought by one person is 125 hectares. It allows large grants of land only to public corporations which it endows for the construction of certain railroads. Thus, the great Pacific Railroad Company has obtained from Congress a grant giving to it over 1,600 meters, right and left of its line, of the public land which this great road crosses.

By an act of Congress dated July 2, 1862, an area of public lands equal to France has been given to the States which have paid the funds required for the erection and first establishment of central schools of agriculture, commerce, and industry.

The United States legislators have set their wits to work to improve all natural advantages by which to render property more accessible to all the colonists, and at an extremely low price, (some few francs per hectare.) Offices are opened for this purpose, and, beside public sales which take place at certain periods, each one can choose the lot which suits him for the mean price of the last public adjudication. He does not wait a month, a week, nor a day for his title-deeds, but receives them at once, and can take possession of his property the same day, free of charge.

The increase in the value of cattle and farm-materials has kept pace with that of landed property during the last ten years.

In 1870, farms were valued, as landed property, at $46,315,000, which makes an average of 17,500 francs for each farm, or 276 francs per hectare.

The capital invested in agricultural machines and implements of husbandry was, at the same time, 1,685,000,000 francs, and the active

capital was valued at 7,626,000,000, in all, 9,311,000,000 of francs.* The price of a farm is 3,500 francs, 55 francs per hectare. Sixty-five francs may be calculated as the maximum, in addition to the value of the seed.

These figures are very inferior for smooth ground to those of France. If we examine the working-capital, which is the third agent of production, we find it comparatively still less. The United States, according to the last statistics, expended in 1870, in wages and cost of maintenance of farm-hands, the sum of 1,555,000,000 francs. This sum divided among the 2,660,000 farms existing at that time gives an average expense of 584 francs per farm, or 9 francs 30 centimes per hectare. However, wages are very high in the United States. Work is not as well done as in our country. The intelligent laborer who understands his business easily obtains 10 to 12 francs a day. In the Pacific districts, and in the Territories not yet made States, a day's wages is about 25 francs. The inexperienced laborer, who has only his hands and no knowledge, receives, in winter, 7 to 8 francs in the Pacific States. During the harvest, when to save the crop at any price is the main thought, the laborer has, so to speak, no more pay. The general average of wages in the New England States is 7 francs 70 centimes. We need not believe that the board of a farm-laborer warrants such high wages. If in the cities of the United States living is very expensive, in the country it is no more so than in France. Food is reckoned on the farms at 2 francs per day for one workman. The expense to the farmers in wages is equivalent, then, to one and a half day's wages for each improved hectare of arable farm-land.

175. These figures result from the economical situation of North America. Land is there abundant and cheap; the colonists are not rich, have little capital, and hand-labor is scarce and expensive. The logical system of agriculture consists in cultivating the largest possible amount of land, which is cheap, with the least possible amount of capital and hand-labor, which are costly. These are the conditions essential to low farming, and are those generally realized in the United States. This is the only reasonable one which could succeed. To do otherwise would result in failure. This is why Washington could write to Sir John Sinclair that the systems of English agriculturists would not suit American colonists, precisely because they were perfected, and all history teaches, in fact, that the emigrants from a rich and well-cultivated state, who have sought to transport the systems, cattle, and cultures of the mother country into countries thinly settled and just growing into public life, have always failed.

The time has not yet come for the United States to carry on high agriculture; it would be at this time the opposite of real progress.

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* The number of farm-horses in 1870 was 7,140,000. The number of oxen was, at the same time, 1,300,000. From these figures it can be estimated that there is one head of working-cattle to 19 hectares cultivated in the United States, proportion to low cultivation. High cultivation has twice or thrice the number.

The products of this low cultivation attained in 1870 a value of $2,448,000,000, (about 12,240,000,000 francs,) in grain, grasses, cotton, and tobacco, and including cattle-feed.

The value of the animals slaughtered, or sold to be slaughtered, in the same time was 2,000,000,000 francs. In reckoning the value of the forage consumed by working-cattle, the real production of the United States in agricultural foods should be estimated at about twelve or thirteen thousand millions of francs;* that is 4,800 francs per farm, or 76 francs per hectare. The product would be 150 francs per hectare, reckoning only the 75,000,000 improved hectares, not including the commons or waste ground; but as these lands maintain cattle, we may value at 120 francs per hectare the portion which really becomes arable land, and at 67 francs the product realized, the expense of hand-labor deducted, for a capital employed (buildings, land, and cattle) of 330 francs per hectare.

Such are the results of the low agriculture of North America. The raw production represents the fifth of the capital invested. The fine farms of France do not give so good a result; the raw production, deducting the cost of hand-labor, is little more than the sixth or even the seventh of the capital invested. The American colonist thus receives a larger interest than we from his capital. This production equals, according to the report on the rural population, 1,200 francs per head, and is very nearly 6,000 francs for each adult employed in agricultural labor.

These figures exceed those of the European statistics; hence it follows that the productive power of the individual in the United States is considerably more than that of agricultural laborers on the Continent, taken as a whole.

The American farmer reaps little per hectare, but by distributing his labor and expense over a great many hectares he produces more and has a larger profit than the farmers in the regions of high culture.

The terms "simple system of agriculture" and "bad agriculture," then, are not synonymous, and the German Ebeling, in his excellent description of the United States, committed a grave error when he complained, on all occasions, in the account of his journey, of the want of ability in American farmers, because they only plow and harrow the surface, not using compost, and not adopting a rotation of crops.

The improvements which we may mention in American agriculture consist, then, far more in the extension of cultivation and in improving new land, than in perfecting the products of that cultivation. These improvements we have referred to. They have made the United States, of all civilized countries, the largest grain-producer.

* In addition to this production, the forage-cultivation has furnished 347,000,000 francs; the cultivation of wood for sale 184,000,000; manufactures 117,000,000.

176. In 1850 this country did not produce more than 290,000,000 of hectoliters; in 1870 it harvested 550, 000, 000, worth 5,000,000,000.*

The quantity of grain from the United States has doubled in twenty years. It has taken Europe sixty years to reach the same result.

The production of grain in France is 335,000,000 hectoliters; in Germany, 350,000,000 hectoliters; in Russia, 500,000,000 hectoliters; in Great Britain, 235,000,000; in Austrian-Hungary, 200,000,000. The United States, which for twenty years sent to Europe nothing but cotton and tobacco, export to-day grain to the value of 400,000,000 francs in a single year.

177. Three kinds of grain form the staple of American culture; these are: 1st. Oats, in the Northern States; 2d. Wheat, on the Atlantic coast, in the States south of the great Northern lakes, and in California, on the Pacific coast; 3d. Indian corn, which comes principally from the vast central region called the Prairies.

Rice, cotton, and sugar-cane, are raised in the warm regions of the South.

Indian corn, of all cultivated grain, gives the largest return in the United States, (20 hectoliters per hectare, on an average.) In twenty years its production has increased 120,000,000 hectoliters; it is to-day from 380,000,000 to 390,000,000 hectoliters. All Europe produces but 70,000,000 hectoliters, or one-fifth of the amount produced in the United States.

In respect to home-consumption, Indian corn plays an important part in the United States, being used for food for man and for fattening cattle, especially hogs; very little is exported.

Wheat constitutes the principal grain of commerce between this continent and the Old World. Its culture has developed more rapidly than any other in the last ten years. Its production has doubled in twenty years, in consequence of double the amount of surface being devoted to it. In 1870, 80,000,000 hectoliters were raised. The average return is, however, that of low culture, varying from 10 to 11 hectoliters per hectare. The sum total of the exportations in grain and flour from the United States amounted last year to 350,000,000 francs. This shows a considerable progress, but a progress, certainly, which should not disturb French producers, for the American producers have to meet heavy expenses, heavy transportation to accomplish, and high-priced laborers to pay, and hence cannot send their wheat to our market except at a price which it would be hurtful to the general interests to see exceeded. It will appear on the continent only when it is needed; it will never be

* The principal producing States are:

	Francs.		Francs.
Illinois	700, 000, 000	Kentucky	230, 000, 000
Indiana	410, 000, 000	Tennessee	300, 000, 000
Ohio	520, 000, 000	Iowa	350, 000, 000
Pennsylvania	600, 000, 000	California, (wheat)	190, 000, 000
New York	750, 000, 000		

sent in average years, much less in times of abundance when the local production suffices for consumption. To think otherwise would be to create purely chimerical fears. It will be with the wheat of the Great West and California as with those of Hungary and Russia, which were recently such a bugbear. It was said that these grains would make wheat as low as 10 and 11 francs per hectoliter or even less. Experience has shown how great this error was. The plentiful arrival of foreign grain kept the market-price within reasonable limits. It ended the era of famine and poverty prices; that is all. Should any one complain about this?

The production of oats in the United States is about equal to ours, or 80,000,000 hectoliters.

In the production of potatoes, the Americans, on account of their low system of cultivation, necessarily present a marked inferiority to the European states. They actually produce only 42,000,000 hectoliters per year, while France produces twice, and Germany four times as much.

178. But the great success of agriculture in the United States is in the industrial products. While in Spanish America the colonists were in a fever for precious metals, and devoted themselves to the seeking of gold and silver, and the Canadians sought wealth in the products of the chase and in the fur-trade, the planters of the United States had the good fortune to introduce into their culture, in the early days of the colonies, a plant admirably suited to their soil and climate, *tobacco*.

Their rulers, understanding that the most substantial basis for insuring the development of the country was the capital resulting from agricultural labor, and that it was not enough simply to insure existence to the inhabitants, favored its culture by every means. Thanks to them, the planters have been able to acquire capital, the want of all new colonies; and here were the first elements of the prosperity and outside commerce of America. Then at the close of the last century cotton appeared, and gave to the Southern States the richest industrial culture perhaps in the world.

After the war of independence the development of these two eminently productive cultures took a new start and soon attained very large proportions.

Cotton culture has reached a still more extraordinary figure. During this same year 1,065,400,000 kilograms of cotton were produced, almost all of which was sent to Europe, bringing to the United States the sum of 1,000,000,000 of francs.

In 1860, 217,000,000 kilograms of tobacco were produced, which gave rise to an exportation of 82,236,000 francs in the same year.

The war of secession came just in time to put a stop to this unheard-of prosperity. The plantations were devastated; buildings burned; store-houses plundered and destroyed. These evils were great enough, but peace added to them. The abolition of slavery took from the planters the labor which was indispensable to them. The emancipated

negroes, left to themselves, refused to work, notwithstanding enormous wages were offered them, (20 to 25 francs per day;) only the most industrious would consent to work every other day, and the destruction of this industry was imminent. While others would have been discouraged and would have abandoned the attempt, the American planters, after the first feeling of dismay had worn off, set to work with savage energy, and to-day, thanks to the diffusion of better tools, to the importation of Indian coolies and especially of Chinese laborers, they have already regained the lost ground.

In fact, the production, which in 1867 had fallen to 200,000 or 300,000 bales of 200 kilograms each, rose in 1870 to 3,000,000 bales, and in 1871 to 3,400,000 bales. Their efforts have been rewarded, and exportation, thanks to the high price of raw textile materials, brought to the United States a sum (1,093,000,000) equal at least to that received before the war, when this culture was at its best; and the New Orleans market has regained its old prosperity.

The tobacco culture has been revived in the same way. The United States produced 262,000,000 kilograms in 1872. Such figures throw the products and profits of other cultures in the background.

179. RECAPITULATION.—Agricultural production of the United States in 1870:

	Hectoliters.		Kilograms.
Wheat, winter $\frac{1}{3}$, summer $\frac{2}{3}$	94,242,000	Potatoes	50,417,000
Rye	5,984,000	Hops	12,900,000
Indian corn	267,858,000	Hemp	6,000
Oats	80,000,000	Flax	14,000,000
Barley	10,476,000	Sugar-cane	39,400,000
Buckwheat	3,457,000	Sorghum-sugar	10,000,000
Pease and beans	2,052,000	Maple-sugar	12,900,000
Spanish potatoes	7,812,000	Bees' wax	631,129
Hay, (tons)	27,416,000	Honey	6,615,000
Linseed	612,000	Cotton, (bales of 200 kilograms	3,000,000
Sirup	857,000	Tobacco	119,017,000
Wine	117,000	Butter	232,800,060
	Kilograms.	Cheese	24,000,800
Milk sold	8,952,000		
Rice	33,357,000		

180. We must mention the attempts which have been made in the United States to add to these great and marvelous industrial cultures, that of beet-root sugar and that of the vine.

As we have seen before, North America is a large importer of sugar and wine. Seeing the immense revenues which France and Germany draw from these productions, the American planters have asked themselves why they should not imitate us. Consequently they have acclimated the beet-root in their country. Their efforts have succeeded in Illinois, Ohio, and on the borders of the Sacramento. Sugar-works have been established. Their culture has not been successful thus far in the Middle States or in California on account of the high price of labor, for the production of the beet-root requires much labor, which makes it

costly; on the other hand, the tools are defective, and labor in the sugar-works was not well directed. The manufacturers have been inefficient, but the idea exists, and, with the enterprising character of the North Americans, there can be no doubt that the cultivation of beet-root sugar will yet be carried on in that country, and after enough is produced to supply home consumption that country may in its turn become an exporter of the article.

181. As to the production of the vine, which is quite as interesting to our agriculturists, the first efforts have been successful. The Californian coasts offer remarkably favorable conditions for the culture of good table-wines, and white wines, which resemble those of the Rhine. They manufacture champagne which the Americans like very much. On account of the enormous duties upon our products sent to the United States, the Californian vine-growers find a ready market for their products. Hence a strong effort is being made to make a vast vineyard in California. Agricultural societies, the Government, and private individuals, are all working for this object. In a few years, it is safe to predict, the production of wine in that country will be very considerable.

Have French vine-growers reason to dread the competition of the planters beyond the Rocky Mountains? We think not. Judging from the samples we have tasted, the wines of California can no more be compared with fine French wines, than can those of the other States of the Union. Bordeaux wines and champagnes alone now go to the ports of North America.

If wine is largely produced in the United States, it will be more generally used as a table-drink, and this will naturally lead to the consumption of our choice wines, which, whatever they may do, will continue to lead the market abroad. Our commerce of wine in the extreme East alone may possibly suffer somewhat, sooner or later.

182. As to animal productions, the United States of America have made an equally remarkable progress during the past ten years. Improvements, as yet, have been rather in increasing the number of cattle than their good qualities and perfecting the breeds. Efforts have been made everywhere to introduce animals of the finest races, such as the Durham, Southdown, English, Percheron, and Norman horses. But there are improvements in detail, that may be noticed here and there in the old States near New York and other large cities of the East and of the Middle States, where agriculture tends strongly to assume the form that it takes on the continent, by reason of the increase of population. They are checked by the enormous increase always going on in the number of ordinary animals raised by agriculturists. This is invariably the consequence of the system of low culture, which gives more attention to number and the quantity than to quality.

The following table indicates the progress realized:

Of animals—

	1860.	1870.	Increase per cent. in ten years.
Horses	6,100,000	8,700,000	42.6
Large cattle	23,000,000	25,000,000	8.7
Sheep	23,000,000	31,000,000	34.8
Hogs	32,000,000	29,400,000	(Diminution.)

Although considerable, this increase is not what it should have been, to judge from the past. The war of secession made its inauspicious influence felt here also. There was between 1862 and 1868 a great destruction of hogs and cattle, and their production was limited. This is evident in comparing the statistics of 1860 and 1870.

	1860.	1870.	Increase per cent. in ten years.
Horses	4,300,000	6,100,000	42.0
Cattle	18,000,000	25,000,000	38.88
Sheep	21,000,000	23,000,000	9.50
Hogs	29,000,000	32,000,000	10.0

The United States possesses to-day three times as many horses as France, twice as many cattle, a quarter more sheep, and at least five times as many hogs. They are also far ahead of Great Britain, which, including Ireland, possessed in 1870:

Horses	2,648,000
Cattle	9,346,000
Sheep	31,403,000
Hogs	4,136,000

They have more cattle than Russian Europe and Russian Asia together, almost as many sheep, and three times as many hogs.

For the surface cultivated North America possesses very nearly the same number of cattle as France*. It has more horses, half as many sheep, but more than twice as many hogs. We find in fact to each 1,000 cultivated hectares:

	United States.	France.
Horses	116	87
Cattle	346	342
Sheep	413	750
Hogs	392	180

It should be remarked, however, that this superiority disappears if we include the uncultivated pastures, which in America maintain a considerable portion of these cattle. It follows, then, that for each 1,000

* In 1872 France possessed—

Horses	2,882,851	Sheep	24,707,500
Cattle	11,284,414	Hogs	5,889,624

cultivated hectares, the colonists of the United States maintain less than half as many cattle as we; they have about 55 horses, 150 head of cattle, 206 sheep, and 195 hogs. But in reference to the population the superiority of the United States in domestic animals re-appears, showing that, from this point of view, their wealth exceeds that of any other country. There are, in fact, to each 1,000 inhabitants:

	United States.	France.
Cattle	650	313
Sheep	775	686
Horses	217	80
Hogs	735	163

This animal population has given to the United States for some years past some importance in the exportation of live stock. In 1870, this country exported to Europe, meat to the value of $235,000,000. The great mass of these productions consists of pork and lard. The lard exported amounted to 50,000,000 francs, and the hams to 40,000,000. Smoked pork was exported to the value of 21,000,000 francs.

The principal center for hog-raising is in the Indian-corn region, and on the wooded plateau of the Apalachian Mountains. These animals are produced more and more extensively. It has already given birth to immense industrial establishments for slaughtering, salting, and smoking.

183. Thus the United States, that twenty years ago exported only tobacco and cotton, sent to the Old World in 1870 the following agricultural foods:

	Francs.
Lard, ham, smoked meat	235,000,000
Grain	400,000,000
Cotton	1,093,000,000
Tobacco	110,000,000
Sundries	60,000,000

Perhaps amounting altogether to the value of 1,900,000,000 of francs of productions of their soil.

And this country has immense waste spaces to cultivate, for it has improved hardly a tenth of its area. As yet, its system of cultivation is essentially low. We can judge from the progress which has taken place in fifty years, what power it may acquire in the future.

The presence of an enterprising race sprung from a stock of austere men of severe habits, animated by a grand religious faith, gifted with great independence of character, attached to the soil and loving to cultivate it, determined above all to create in their new country a manly society after their own image: this is the first cause of the development of the United States. Their manners have changed since, their sentiments are more or less modified, but the basis of the character is still there. The granite foundation on which the edifice rests exists always, and insures its stability for the future.

The other causes which have favored this prodigious evolution are:

The almost unlimited abundance of a soil ready for cultivation, and having a propitious climate; the existence of a legislation, giving to all, without distinction, the greatest facilities for acquiring land at a very low price, favoring the establishment of each colonist, and the absence of all laws of a nature to fetter the colonist in any way whatever, in his labors or his recreations.

The development of civil and political institutions imprinting on every character energy, the feeling of dependence on one's self, and consequently the spirit of *self-government*.

The high wages.

The facilities for transportation by land and water.*

The application to the soil simply of the system of low culture capable of being actually remunerative, and the introduction in the culture at the beginning of colonization, that is, at just the right moment, of two useful plants, marvelously appropriate to the soils and varied climate of the country, and of a nature to furnish an abundance of capital, that which is most needful to the early pioneers, and that which is the first and greatest want of all new colonies.

There are lessons enough here for us, for our colonies, and especially for Algeria. They are self-evident, and amply justify our lengthy report.

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*Independently of the magnificent rivers which afford to this country a most commodious interior navigation, the greatest development has been in the roads, the canals, and above all, the railroads. In 1870 there were 85,440 kilometers of railroad in use in the United States. These railroads carried, during this same year, 95,000,000 tons of merchandise. In 1860 the tonnage per head transported was 1,200 livers. In 1870 it was 3,816 livers. Each year sees an increase in the extent of railroads and canals.

GROUP IV.

WINES AND SPIRITUOUS LIQUORS.

REPORT OF M. TEISSONIÈRE.

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184. Since 1860 the vine-culture has made a considerable advance in North America. Almost all the States are producing wine; but it is in California, Virginia, Carolina, Massachusetts, and Ohio that the greatest quantities are produced. Many of the French, Spanish, and German vines have been there introduced, and the production, which in 1850 was 10,000 hectoliters, may be estimated to-day at 130,000 hectoliters.

The products exhibited at Vienna were in number 82 samples of wine, and 16 of spirituous liquors, brought by 27 exhibitors. We have noted the real improvement on those exhibited in 1867; the petroleum taste which characterized the wines of 1867 has disappeared; this later wine was agreeable to the taste, and of good color; the thin white wines were also of good quality, and the sparkling wines were very well made.

The spirituous liquors distilled in North America have rice and grain for the basis; the first are called arraeks, and are produced in considerable quantities; they are well distilled; they are perfectly free from impurities.

A small number of sweet liquors without special characteristics were exhibited.

En résumé, incontestable progress in production and in manufacture has taken place.

Medals of progress	2
Medals of merit	5
Honorable mentions	8
Awards total	15

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185. To recapitulate, the Exhibition of 1873, at Vienna, shows us in general viticulture progressing as to production and quality. We ourselves wish especially to call attention to the progress of what we will call ordinary wine; that is, the wine that is destined to be the daily drink of the majority of families, and which is the bulk of the production, not wishing to occupy ourselves exclusively with fine wines, which definitively could represent but an infinitesimal portion of the production and consumption. In fact, the fine wine produced by a soil of a special quality, could exceed a given production only in losing the qualities which give it its rank, and, consequently, entering the category of ordinary wines; the classes which consume it having a great price to pay, have a right to be particular, and to admit on their tables only an

article of more than ordinary quality; if, on the contrary, there begins to appear on the table of the artisan, of the employé, in a word, of those of small means, a production of irreproachable taste, possessing nutritive qualities such as the consumer finds beneficial to his health, of tone enough to lessen the amount of his ordinary food, at a price accessible to those of small means, then a problem will be solved useful to humanity; this will be, also, the best remedy for the abuse of wine; for where wine is so abundant as to allow of unlimited consumption, drunkenness is so rare as to be almost unknown. We consider, then, an excellent advance toward this result, the progress in the department of viticulture shown at the Universal Exhibition of 1873 at Vienna.

The following is at this time the average vinous production of the whole world:

	Hectoliters.
France	56,000,000
Italy	35,000,000
Spain	20,000,000
Turkey	1,500,000
Portugal	3,500,000
Austria	18,500,000
Hungary	7,000,000
Germany	4,500,000
Russia	3,500,000
Roumania	1,000,000
Switzerland	500,000
North America and Brazil	1,500,000
Total	152,500,000

Of this production, France produces approximately one-third, and a single French department, the Hérault, one-tenth. If we look at the figures showing the exportation of this production from each country, we shall find that, aside from Portugal, which exports from a quarter to a sixth of their production, the rest is almost insignificant; thus France exports no wine at all, if we deduct from her exportation the amount imported by her from Italy, Spain, and Portugal, an importation which would be all right if the object of it were to introduce what France does not produce, but which is not well, when one knows that there are differences of price, of grade, or anything else which cause it; the day when the fetters, which bind so closely the circulation and manipulation of wines, are broken, commerce, consumption, and especially exportation will take a most extraordinary development.

GROUP V.

SILKS.

REPORT OF M. DAMPLINOT.

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186. The rearing of silk-worms is, perhaps, the oldest American industry of foreign origin; it was introduced by the English at the beginning of the seventeenth century. In this and the next century it increased rapidly, both in Virginia and in Georgia, the Carolinas and Ohio. It was successively established in fifteen States, and neither protective duties, pecuniary encouragement, nor capital were wanting to the numerous enterprises which were for a long time maintained and finally abandoned. The result was not what was hoped and desired.

In the thirty years, (from 1812 to 1844,) from 150,000 to 180,000 cocoons were produced, but now the amount is probably a little less. This feeble production supports the small silk-mills in Virginia, Kentucky, Georgia, and Tennessee.

187. The manufacture of silk goods is conducted with activity. The silk-throwing establishments produced in 1873, of American fabrics, 146,000 kilograms of organzines and of tram of the value of 15,400,000 francs.

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The United States consumed in 1872, silk stuffs to the value of 150,000,000 francs. The American manufactories furnished one-tenth, worth 15,640,000, of which 8,000,000 were foulards and handkerchiefs, and the amount has increased of late.

The silk industry of the United States represents, as a whole, a value of 91,500,000 francs. Deducting worked silks, there remains a value of 74,300,000 francs for the actual manufactures, to wit:

	Francs.
Pure or mixed silks	15,640,000
Silk ribbons	12,200,000
Lace-work and embroidery	15,900,000
Sewing-silks	30,600,000

We confine ourselves to a repetition of these facts, for the productions are unknown to us. None of them have been sent to the Vienna Exhibition.

COTTON GOODS.

REPORT OF M. ADOLPHE DELHAYE,

188. Since the Universal Expositition of Paris in 1867, all the countries which cultivate cotton continue to produce quite as much as before the war. America produced in 1872–73 about 3,800,000 bales; Brazil

700,000; Egypt 400,000; the Western Islands 200,000; the West Indies 1,000,000 bales; total, 6,100,000 bales.

This amount is sufficient to supply the 70,000,000 spindles of the whole world.

Since the Exposition of 1867, the number of spindles has considerably increased. in England this increase is 20 per cent., and all the countries have likewise increased the number of their mills.

	1867. Spindles.	1873. Spindles.
England had	34,000,000	41,000,000
United States	8,000,000	11,000,000
France*	6,800,000	6,000,000
German Empire†	2,000,000	4,000,000
Austria	1,500,000	1,700,000
Russia	1,500,500	1,600,000
Switzerland	1,000,000	1,400,000
Belgium	625,000	800,000
Spain	700,000	700,000
Italy	300,000	.. ..
Other countries	.....	200,000

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We much regret that this great country. which has to-day about 11,000,000 spindles, and which holds the second place in the working of cotton, consuming already 1,000,000 bales, should wholly abstain from exhibiting cotton goods.

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* France had 8,000,000, but from this number it is necessary to strike off the 2,000,000 spindles of Alsace Lorraine, leaving 6,000,000 spindles.

† To-day with the 2,000,000 spindles of Alsace Lorraine, the German Empire has 4,000,000.

GROUP VI.

LEATHER AND CAOUTCHOUC.

Report of M. Charles Soyer.

189. America exhibited sole-leather, a part tanned with pure oak-bark, a part with hemlock, (the Canada fir,) and part with mixed tanning, oak and hemlock.

In this country the skins from the neighborhood of the cities are generally tanned with oak-bark; they are of firm appearance and of good quality, but rather lacking in strength, while the skins brought from Texas are tanned with hemlock, which gives them a reddish-brown color, with still less strength.

The house of Anthony P. Baer & Co., Baltimore, Md., presented sole-leather of very good quality, tanned with oak-bark; the American representative told us that this leather was tanned in eight months; that which I saw was more than well tanned, quite hard and of a beautiful color.

The other exhibitors of sole-leather tanned with oak-bark are Messrs. Conrad, Fabel & Mooney, of Louisville, Ky., and Messrs. Frantz & Son, of the same State, whose leather is also well tanned.

Messrs. Buckley, Lockwood & Co., of New York, had leather of combined oak and hemlock tannage, very successfully tanned. It seemed to me much like the productions of other New York exhibitors.

Messrs. Franklin Upton & Co., of Boston, exhibited dressed leather for soles, which they said had been tanned in sixty days by a new method, that I believe to be an imitation of the Knoderer system, a system well known in France, and but little employed now. This leather tanned with oak-hemlock was not a success, and the official report said with reason, "We are not enthusiastic about the quality of this leather."

Several manufacturers exhibited leather tanned with hemlock alone. Messrs. Bush & Howard, of Buffalo, New York, deserve the first place as much for their commercial importance as for their excellence of manufacture. The skins exhibited by these gentlemen were the best of the sole-leather tanned by hemlock.

I should state that in America the production of sole-leather has made great progress. In these latter years it has been gaining more and more importance in foreign markets. Although in these leathers there is still room for improvement, their relative cheapness insures them a large sale.

The official report says, "The American tans his leather in much less time than the German, and this fact, alone, contains a warning for the greater part of the tanners on the continent."

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COW, CALF, AND HORSE SKINS USED FOR LEATHER.

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190. Only two exhibitors of these specialties, Messrs. H. G. Ely and Sanger of New York, produced a black cow's rump, remolded as leather, the grain of which, in imitation of goat shagreen, was very successful, but the quality was ordinary.

Wisconsin Leather Company had cow-hide waxed on the flesh side, of good quality, and particularly well cut; the work was performed by a new machine, which can work, they say, 150 to 200 skins per day, but we have been unable to obtain the precise details of it. They had also three tanned and waxed leathers for boots, which were very well prepared.

Of patent leather, polished and grained, America sent nothing.

GROUP XII.

GRAPHIC ARTS.

REPORT OF M. G. MASSON.

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191. We regret that the greater part of the publishers of the United States failed to appear at this international meeting to which they were invited; it would have been interesting to study in all its details a production that we know to be so considerable. However, Group XXVI, in which were represented several important publishers, as Lippincott, Wilsen, Brewer, permitted us to examine the current type of work.

The execution is, in general, good, although not elegant, but still suitable to this class of work. The prices are, so far as we could ascertain, higher than in France. The exhibition of great works of natural history and of official publications of statistics, made at the cost of the Government, shows that there are employed, for this class of work, very able workmen.

A single publishing-house, the Appletons, of New York, challenged the judgment of the jury of Group XII. They had sent only one very fine work, in two volumes, in quarto, illustrated with wood engravings, and called *Picturesque America*. This seems to be entirely home-labor, and while it cannot rival *La Touraine* or *Les Jardins*, either as to engravings or binding, this book gives evidence of efforts which we must not pass over without mention.

It is evident that the publication of periodicals has developed largely in the United States. One bookseller, of New York, M. Steiger, conceived the idea of collecting and exhibiting specimen numbers of more than six thousand journals, published in America. This shows what a field this country offers to publishers and printers.

GROUP XII.

PHOTOGRAPHY.

REPORT OF M. A. DAVANNE.

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192. The number and nature of the awards obtained may be seen in the subjoined table:

*General résumé.**

Nationalities.	Beyond competition.	Diplomas of honor.	Medals of progress.	Medals of merit.	Medals of good taste.	Diplomas of merit.	No award.	Number of exhibitors.	Co-operating with exhibitors.
Austria	2	1	16	35	6	27	7	94	8
Hungary	0	0	0	6	1	6	4	17	0
Germany	1	1	8	41	4	30	8	93	5
France	0	1	10	16	1	10	2	40	1
Italy	0	0	3	6	0	16	6	31	0
Russia	0	1	3	7	0	9	3	23	1
England	0	0	0	7	2	4	1	14	0
United States	0	0	4	6	1	4	0	15	0
Denmark	0	0	1	3	0	5	5	14	0
Switzerland	0	0	0	4	0	5	6	15	0
Spain	1	0	0	3	0	4	2	10	0
Portugal	0	0	1	2	0	2	3	8	0
Belgium	0	0	4	2	0	2	0	8	0
Sweden	0	0	0	3	0	3	1	7	0
Norway	0	0	0	2	0	1	0	3	0
Holland	0	0	1	2	1	1	0	5	1
Turkey	0	0	1	0	0	3	0	4	1
Greece	0	0	1	1	0	0	0	2	0
Roumania	0	0	0	1	0	0	0	1	0
Total	4	4	53	147	16	132	48	404	17

* This recapitulation is made according to the number of exhibitors judged by the jury and not according to the catalogues, several of the names indicated not having exhibited.

Proving that French photography, considering the number of its exhibitors, holds a very important place in the total of awards; but we should add that the greater part of the other nations, Austria, Germany, and North America, especially, have made great progress, and if our march should be retarded, if we should not know how to reap the benefit, as our foreign competitors have done, of the examples of labor and progress which have been given us, we should at no distant day find ourselves surpassed.

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S. 2. DIRECT POSITIVE PROOFS.

We have not found in the Exhibition of 1873 a single one of proofs obtained directly from the camera. This process, in which silver reduced by sulphate of iron forms the white, by contrast with the dark

ground given, the dark shades and half-tints, seems to have found a refuge in America, where it is still practiced under the name of ferrotype, because they use a thin leaf of sheet-iron, covered with varnish resistant enough to be uninjured by contact with the baths. Anthony, of New York, exhibited some of these sheet-iron leaves; there is found the sole remnant of a process likely to be forgotten among us, unless we can find for it another application than for portraits.

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In America, with the beautiful proofs without retouching or touching up, but always very artistic, which were exhibited by Mr. Kurtz, we will class those of Mr. Howell, harmonious in tone, but often a little affected in the pose, and some instantaneous portraits of infants by Mr. Landy, sometimes smiling, and not so pleasing as those which we remember of Messrs. Laescher & Petsch.

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S. 1. Astronomy.

193. The samples of astronomical photography were few in number at the Exhibition of 1873. Doubtless the reasons of this are the labors and preparatory trials of the principal observatories, which are preparing for the approaching observation of the passage of Venus. Photography should play a considerable rôle in these observations, and in France, as elsewhere, they are preparing themselves by very earnest study. We found in the exhibition of Portugal some proofs representing automatic apparatus which work at the observatory of the Infante don Luis. In Spain there are some samples, a great deal too light and soft, of a picture of the moon; but in Belgium, Mr. Neyt exhibited very beautiful proofs of this satellite, of remarkable clearness, although less magnified than those sent to Paris by Mr. Rutherford.

GROUP XIII.

MACHINERY.

REPORT OF M. TRESCA.

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194. PRIME MOVERS.—We need not hesitate to say that we are behind the times as respects steam-engines; and doubtless because we possessed, until within some years, more perfect and more economical machines, we counted too much on the earlier superiority, and disdained too much the real progress inaugurated by the arrangement of the American engine of Corliss, which has been everywhere else the starting-point of these later improvements.

To judge by the engines exhibited, England has continued almost as indifferent as we to this movement so much complained of in Belgium, Switzerland, Germany, and Austria, and so interesting, meantime, since it is marked by a notable economy in that fuel, the necessity of which is constantly felt in all industrial countries.

The principal characteristic of the Corliss engine is its mode of steam distribution; the steam and exhaust ports are in separate chambers, and are usually placed respectively at the upper and lower part of the cyl nder, which is generally horizontal. The valves are kept closed by springs, and opened during the time strictly necessary by means of a valve-gear, operated by the engine or by its governor. The whole presents, as to arrangement, a peculiar form which may be seen at a glance and which insures great durability.

As to the details of construction they are extremely varied, each builder, while imitating the general disposition, having recourse to such an arrangement as best suits him. The main object is always the same; to give the point of cut-off the widest range from 0 to 0.70 of its stroke, by the action of the governor, and to insure the prompt opening of the steam and exhaust ports, and their closing with equal promptness. It is impossible to obtain by even the most carefully-planned arrangement of slide-valves, and by the use of multiplied openings, either the same instantaneousness of action, the same range of steam admission, or the same prompt response to the slightest indications of the governor.

The separation of the passages renders the escape of the steam entirely independent of the admission, and greatly economizes the steam by avoiding the changes of heat ordinarily produced in the passages where circulate, alternately, the heated steam coming from the generator and that cooled and partly condensed at the moment that its mechanical action ceases.

We cannot say that the Corliss engine with a single cylinder is entirely free from this disadvantage, since the expansion is effected in the

same space, and therefore passes through the same variations of temperature; the Woolf engine is better designed in this respect, since the variations of temperature are more limited in each of the cylinders composing it.

Our attention is persistently called to the effect produced in the new engines by the application of a steam-jacket. Messrs. Sulzer, of Winterthur, whose engine has been most appreciated, has made known to us the results of comparative experiments by which they are assured that the use of a steam-jacket leads to an economy of at least 20 per cent. in Corliss engines; it is very nearly the same for engines with slide-valves, and these experienced builders no longer hesitate to consider the heating of the cylinder by the circulation of steam around it, as one of the conditions of the economical employment of steam in the Corliss engines as in others.

The consumption of engines of this class when provided with a condenser, is reduced to one kilogram of fuel per horse-power per hour; or better, to eliminate the effect of the boiler altogether, it does not exceed 7 kilograms of steam in the same time. This is very far from 25 kilograms of water, which was considered for twenty years the normal consumption of steam-engines.

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195. Working of metals.—Machines for working metals were much more limited in number than at the Exhibition of 1867. Mr. Sellers, of New York, Messrs. Sharp, Stewart & Co., of Manchester, Messrs. Ducommun & Steinlen, of Mülhouse, were evidently of the first-class as respects invention as well as execution.

The great workshops of Chemnitz, which had given us a very high opinion of the machine-tools of Germany, by the great variety of well-executed and not high-priced examples which they exhibited at the competitions of 1862 and 1867, have made no progress since then, and these are to-day the same types, and copied for the most part from the same patterns.

The diplomas of honor awarded to them at a second meeting had been very justly contested, at least in our opinion, at the time of the first deliberation. It is only just, on the contrary, to give the highest honors to the beautiful exhibition of this kind made by several American builders.

196. The number of designs perfectly elaborated and also well executed, in the important exhibition of Sellers & Co., constituted the most beautiful series in the whole Exhibition. The Messrs. Sellers have, however, modified nothing; neither that arrangement in their turning-lathe for varying speeds by means of friction plates, which excited so much attention in the Exhibition of 1867, nor the arrangement of the principal organs of their automatic machine for cutting gearing, which is certainly the most complete of this class. But still this exhibition

has that character of general perfection which gave them in 1867 a place among the best constructors of machine-tools.

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197. WORKING WOOD.—The machines for working wood have not been very much improved since the Exhibition of 1867, unless perhaps in America, where we noticed a series of machines for the manufacture of carriage-wheels, by the use of certain especially adapted means of compression of the wood.

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198. SEWING-MACHINES.—The sewing-machine has become wholly indispensable in the household. Knitting-machines will yet become as indispensable, and we may be allowed to notice here the improvement that one of our expert mechanicians, M. Charbonnier, is known to have made on the original model of Mr. Lamb. The beautiful knitting-machine of Mr. Howe, of New York, was the most important of all.

GROUP XIV.

INSTRUMENTS OF PRECISION.

Report of M. Onimus.

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199. Dental plates.—A great many dentists exhibited artificial pieces, but we may say, without fear of contradiction, that this sort of exhibition is of little interest. How can we appreciate the value of these pieces unless we can see at the same time the case for which they were made, and know whether the patient was able to make use of them? Hence, we cannot see what are the scientific reasons which led the dentists to make this exhibition. If they did not rightly belong to this class, they could not elsewhere be compared with the makers of artificial teeth and instruments of dental surgery, the industrial exhibition of which is useful and worthy of encouragement.

The American manufacturers exhibited artificial teeth and apparatus for dental surgery. These are Mr. Samuel White and Mr. Justi, both of Philadelphia.

As was the case at the Universal Exposition of 1867, the American exhibitors are incontestably superior to others in all that concerns the dental art.

Samuel White, the leading manufacturer in this branch of industry for a number of years, has a great reputation as a maker of artificial teeth. These have the color and form of natural teeth, and at the same time are very durable.

Since the Paris Exposition, Mr. White, in order to give more durability to mounting on plates, has begun to introduce platina in the interior of the tooth. He exhibits at the same time two small new machines intended, the one to perforate or to excavate the artificial teeth, and the other to fill the teeth. These two machines are worked by electricity, which gives, by means of special mechanisms, to the one very great speed, thus enabling it to perforate hard substances, and to the other a constant pressure.

Mr. White also exhibited gold leaves of a new make; these "globe" leaves are very ductile, and at the same time resistant and coherent.

Next after this firm, and standing almost as high, is the house of Asch & Sons, of London. Their artificial teeth are quite as well made, and their form and enamel are excellent. They are a little less transparent than those of Mr. White, but this slight fault is compensated by great durability.

GROUP XVI.

THE ART OF WAR.

REPORT OF M. MERTIAN.

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200. The military exhibition of North America is not as interesting as it should be. It is limited almost exclusively to small-arms already known, and although the names of most of the exhibitors may be names celebrated for the manufacture of fire-arms, such as Remington, Sharpe, Smith & Wesson, &c., we may be allowed to say that they have made but little progress for several years in the arrangement and making of these arms. This remark which was made by most of the members of Group XVI, is also applicable to almost all countries so far as small-arms, loaded at the breech, are concerned. The study of these arms, which made such rapid progress after the war of 1866, solved, as we may say at one time, the different problems that this interesting subject seemed to offer, and the Universal Exhibition of Vienna presented in this respect almost nothing which has not been known for several years. One thing, however, is to be remarked: that is the general abandonment of the combustible cartridge. When France shall have adopted a metallic cartridge fired at the center, this system will be in use with all the great European powers.

201. MANUFACTURES OF FIRE-ARMS BY THE COLT COMPANY, HARTFORD, CONN.—The Colt system is a simple modification of the Remington, its object being to avoid the danger which is sometimes caused in the Remington at the moment of firing, the tension of the gas being great enough to make the breech-block recoil and cock the weapon. To remedy this Colt has divided the Remington breech-block into two parts in the line of the axis of the weapon. These two parts are cocked separately, and the left cannot be cocked unless the right is so already. The right is of a greater depth than the left, and the gas has no effect upon it. It holds the neighboring part securely during the fire, and absolutely prevents self-cocking. The defect of this system is its complication, which is perhaps out of proportion to the very rare chance of accident which the ordinary Remington offers. The arms were of good make and the jury awarded to them a medal of merit.

202. SMITH & WESSON, SPRINGFIELD, MASS.—The exhibition of revolvers of the Smith & Wesson system. This system is so well known that no description is necessary. These arms were of excellent make, and obtained a medal of merit.

203. SHARPE'S MANUFACTORY, HARTFORD, CONN.—Exhibition of fire-arms, muskets, and rifles, of different sizes, and all having the same breech-fastening, called Sharpe's fastening or slide. Medal of merit.

204. MANUFACTORY OF ARMS, SPRINGFIELD, MASS.—Exhibition of fire-arms of different systems and particularly of Springfield muskets, with bolt system, and of muskets falling-breech system. These last

are of two sorts. In one the stock is of a single piece, and the movement of the breech is produced by a lever serving for a prolongation of the breech itself, at the side of the but. In the others the stock is in two parts, and the movement of the breech is made by means of the guard. Good work. Medal of merit.

205. PROVIDENCE TOOL COMPANY, PROVIDENCE, R. I.—Peabody breech-loaders. Different models, all celebrated. Good work. Medal of merit.

REMINGTON & SONS, ILION, N. Y., ARMS AND AMMUNITION.—Very beautiful exhibition of muskets, rifles, and pistols.

Remington system.—In some of these arms the cock sets itself with certainty, when after loading they turn down the breech-block against the cartridge; it must then be cocked anew before firing. These arms are very beautiful and remarkably well made. It is to be regretted that they obtained only the medal of merit, as in the preceding exhibitions.

UNION CARTRIDGE COMPANY, (not catalogued.)—Beautiful exhibition of metallic cartridges for all systems. Medal of merit.

SCHUYLER (Bridgeport company) not catalogued.—Metallic cartridges for all systems. Medal of merit.

MEIGS REPEATING MUSKETS (without competition) not catalogued.—This arm carries 50 cartridges, introduced at the but on five parallel lines of 10 cartridges each. A slide, in place of the guard, goes behind after them, and passes them successively to their places. This weapon, which could not be used by an army in the field, could, perhaps, be of service in the fortification, and replace advantageously the mitrailleuses on the ramparts, if they were somewhat modified and well constructed.

206. SCHUYLER, HARTLEY & GRAHAM, NEW YORK.—WAR DEPARTMENT, Schuylkill Arsenal, Philadelphia.—Under two numbers, which form two distinct exhibitions, are exhibited several objects of equipment, and particularly two cavalry-saddles, one under No. 578, and the other under No. 585. These two saddles are sufficiently alike in form to be described together. Their great simplicity, lightness, and original form merit some attention. They are composed essentially of two thin narrow iron plates, which form the sides of the saddle, and which bear on the horse's back each side of the spinal column. They are bound together by a saddle-bow and cantle, also of iron. The two sides, the saddle-bow, and cantle are covered with leather without padding. Between the two plates, therefore, there remains a space about 10 centimeters wide and of the same length as the saddle, so that the spinal column of the horse is uncovered. Between the saddle and the horse is a very thick cloth, which takes the place of the padding in our saddles, and fills, in part, the space between the two sides. Only the thighs of the rider, then, are in contact with the saddle, and the knees rest upon the cloth. Both of these are very light and easy to make, but they absolutely require a very thick cloth. The first obtained an honorable mention, and the second a medal of merit.

GROUP XVIII.

CIVIL ENGINEERING.

REPORT OF M. KLEITZ.

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207. The United States of North America abstained almost entirely from taking part in the exhibition which formed Group XVIII. They sent a few designs for school-houses and other buildings with which we have not concerned ourselves in the present report. As to public works, we have only to mention particularly a very small number.

The Sutro Company, of Nevada, exhibited drawings of a tunnel 6,100 meters long, which had been executed for the working of metalliferous deposits. We lack the information necessary to a proper appreciation of this work, which seems to have presented serious difficulties on account of the extreme hardness of the rock.

208. Maj. Gen. John Newton, of New York, exhibited a model of the work of rock-removal at the reef at Hallett's Point, one of those rocks which form an obstacle to the arrival of large ships at New York by the pass called Hell-Gate.

M. Malézieux, in the report of his travels in America, page 399, has aided us to understand in what these labors consist; we will supplement the information he gave us by that contained in the account presented us at Vienna.

The bed of rock in question lies but $3^{m}.70$ below the mean level of the sea, for a distance of more than 800 meters along the shore. It is proposed to increase this depth to 8 meters, and for that the extractions should extend over a surface of about 126,500 square meters, and form a volume of 38,470 cubic meters. They wish to blow up this mass of rock *en bloc*. As for the *débris*, that can be raised afterward by means of drags furnished with claws.

The work was carried on in this way: They first formed a coffer-dam fastened at the side. This coffer-dam, filled with clay and gravel, is but $1^{m}.60$ in height, and of easy construction. Within this space the rock is laid bare and dry, and then they advance outside of its perimeter, proceeding to the desired depth, and excavating concentric and radiating galleries just far enough apart to leave between them pillars of the rock about 3 meters thick to hold up the roof of this vast under ground quarry.

The galleries are about $1^{m}.50$ in height and width. Six of these circular galleries are continuous and describe almost semicircles, resting on the gallery which runs along the shore. In front of the sixth they reached the points of the reef farther forward, by small supplementary galleries. There are five of the radiating galleries.

The rock is a very hard gneiss, with almost vertical stratification, and very slightly pervious. The drainage is easily accomplished.

The drilling of the holes for blasting is accomplished by machines with compressed air, generally by percussion-machines, sometimes by diamond drills. Hand-drilling is also employed. The holes are from 90 centimeters to 1m.20 in depth. The charge for each hole is about 8 ounces (226 gr. 70 centig.) of nitro-glycerine. They use these small charges so as to avoid shaking the roof and pillars of the galleries.

The coffer-dam was begun in July, 1869. The 1st of February, 1873, the total length of the galleries was 1,437 meters, and the work of exploration was about finished. They had discharged at this time 20,000 charges without accident.

We have been unable to ascertain exactly what they were doing in the month of August last. The final explosion has not yet taken place. We have been told since that the galleries are to be enlarged in such a way as to greatly increase the excavation, in which the greater part of the *débris* could remain buried without hinderance to navigation.

The experience at San Francisco, where a submarine rock has been razed by a similar proceeding, has, in fact, shown that the raising of the *débris* by means of drags is very costly, and that it is advisable to reduce the quantity as far as possible. (See the memorandum of M. Malézieux, page 393.)

This method of removing submarine rock is very remarkable. When circumstances allow of its use, and when the masses to be taken out are considerable, it seems to offer more than one advantage over the ordinary methods of drilling blast-holes at the surface of the rock, by means of machines more or less perfect. They intend to apply the same mode of extraction used at Hell-Gate to the removing of another reef in order to enlarge the channel to 365 meters.

209. Mr. Albert Fink exhibited the model and drawings of the great railroad-bridge of Louisville, Ky., built by him over the Ohio, according to a system to which he has given his name.

M. Malézieux has made known in his report (page 42, plate X) in what the arrangement of this bridge consists. It was opened for traffic in February, 1870.

It is composed of twenty-seven iron trusses. In twenty-three trusses, the chords are below the flooring and form a horizontal longitudinal member, which is supported at intervals between the piers by struts, beneath which pass rods fastened to the chord, either at its extremities or at intermediate points. The rods which pass beneath the central strut to the ends of the chord, have an inclination of about 1 perpendicular to 5 horizontal. The assemblages, moreover, are articulated and not rigid, like most in use in America. These chords belong to the system of truss girders.

In the four other trusses which permit the passage of vessels, the chords are above the flooring, and consist of an upper and lower longi-

tudinal member, both horizontal, and fastened together by uprights and by braces inclined at 45°, triangulated in the form of a **V**.

The twenty-three trusses have spans varying from 45^{m}. 50 to 75^{m}. 50 between the centers of the piers. Those with upper girders have a span of as much as 122 meters. The latter girders are 15 meters in height, and are braced at equal intervals throughout their height.*

The total length of the bridge is about 1,600 meters. It has a single paved roadway. The total weight of iron used in the construction is about 3,950 tons.

The system of Mr. Fink has been applied to several important bridges in America, and, it must be admitted, with economy. Still, it certainly does not present so much rigidity as the different systems of chords adopted in Europe, and doubtless the latter will not continue to be employed. The system adopted by Mr. Fink for the bridges over navigable channels seems to us open to criticism.

* By the elevation shown on Plate X, of the account of M. Malézieux, it would seem that two of the navigable passes are formed by a swing-bridge of 81 meters total length.

GROUP XXVI.

EDUCATION.

REPORT OF M. E. LEVASSEUR.

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210. PRIMARY INSTRUCTION.—The public instruction of the United States is of special interest by reason of the extent of its development and of the original character of its institutions of learning. It occupied the thoughts of the legislators long before their independence. The austere Puritans who first colonized America carried, with the Bible, care for intellectual culture. We must go back as far as the year 1642, twenty years after the time when the pilgrim fathers landed from the Mayflower in Massachusetts Bay, to find the first idea of the foundation of free public schools.*

The legislature of the State five years after, in 1647, established a law directing that each township containing fifty families should be obliged to maintain a teacher to instruct all the boys and girls in that locality in reading and writing; that each township having one hundred families should have a grammar-school.†

When the United States, having secured its independence, was maturing a constitution, Washington expressed the thought of his fellow-citizens by saying, in Congress, that "in all countries instruction is the surest basis of public good; but among a people where the measures adopted by the government depend so much upon the ruling ideas, as in the United States, instruction is indispensable."‡

After emancipation the problem was complicated. Immigration was introducing each year a large number of adults, many of whom, especially among the Irish, were illiterate; it was, in a measure, an invasion of illiterates. In 1840, at the time of the first statistics, there were found to be 549,000 whites above the age of twenty who could neither read nor write; in 1870 there were 1,871,000. In the South the evil is especially great; in the North they estimated only 5.7 per cent. illiterate, of which half were foreigners; in the West, 11 per cent.; in the South, 29 per cent. "If an armed enemy," writes Mr. Eaton, Commissioner of the Bureau of Education, "menaced our frontiers, the entire nation would rise to arms. But battalions of enemies, yet more indomitable than those without, already occupy our towns and villages. The

* Horace Mann, who was from 1837 to 1849 the superintendent of education of the bureau of Boston, and who was the real founder of the system of American schools, wrote: "Massachusetts had the honor of establishing the first system of free schools in the world."

† M. Hippeau: "Public Instruction in the United States."

‡ Cited by M. Laveleye in "The Instruction of the People," p. 337.

great army of ignorance is advancing, ever larger and more nearly invincible. History shows us with what difficulty they arrive at civilization, and with what facility they fall back into barbarism."

The Americans have always considered public instruction one of the wheels of their political system, and they have formed their system of teaching on this idea. "To prepare a people for self-government," said Barnard, "it is necessary first of all to develop the moral sense; if the intellect alone is cultivated, nothing is accomplished." "Education," said Horace Greeley, "should have for its aim the development of the entire nature, moral, intellectual, and physical. It should make a man whose intellect should be enlightened and active, sentiments pure and steadfast, body beautiful and vigorous. The more cultivated a man's intellect is, the more productive is his labor."

The primary school takes in nearly all the children of the different classes of society, from five to ten years of age. They are taught reading, writing, arithmetic, geography, some idea of the sciences, and of constitutional law. "Facts, not rules; examples, information, not maxims; that is the order," said M. Hippeau, "and this order is apposite to the object which the Americans keep in view. Hence, they multiply pictures and engravings, and use object-lessons even more than the Germans do. They drill the child in speaking, accustom it to recite verses, to expound a problem, and even to debate. They seek to train up citizens. From time to time, the exercises are interrupted by marches to the accompaniment of the piano and songs, as we practice in the asylums or in the method of mutual instruction. The schools being at the same time public and free, and open to all children without distinction of religion, as without distinction of sex, religious instruction forms no part of the programme. Although the Bible is read everywhere and a prayer offered, this is done after class hours, by the ministers of religion."

On leaving the primary school the children enter the grammar-school, of which the course is from four to five years. Here the programme includes reading, writing, practical grammar, history, geography, composition, Latin, arithmetic, geometry, book-keeping, French, German, &c. This is in some sort a primary high school, and gives some notion of the Latin language.

To form citizens of a democratic society, the Americans have thought that it would be necessary for all to participate in the same teaching. "If, in order to maintain our schools," said the superintendent of instruction in Ohio, "we do not hesitate to levy heavy taxes, it is because we are convinced that the security of the state and the stability of society depend on the general diffusion of intelligence and virtue, fruits of a good education. Free schools are the means by which to accomplish this end." In the annual report of the committee of education of the city of Boston, we read: "One of the benefits of public education is that the children of the workman and of the merchant, seated side by side,

associates in infancy, will be sympathizers and companions one for the other throughout the remainder of the journey of life."

In order to have free schools it was necessary to pay a large amount to the schools from the public revenues. The United States has spared nothing in this respect. This is one of the most remarkable features of their institutions of learning.

211. The schools are under the jurisdiction of each particular State, which regulates the subject by particular laws. In the Middle States, and those of the West which have been recently settled, they form no township without reserving one out of every thirty-six lots of land (the one in the center, and consequently the best) for schools; this is endowment before birth. This lot is sold or rented in lots, and thus the schoolhouse is built at the same time as the farm-houses from which it receives the children. Moreover, the greater part of the schools are incorporated, that is to say, constituted civil bodies. They receive an endowment and the rental.

In 1835 the Federal Government possessed a sum of $150,000,000; they distributed it among the States, and most of them considered it a deposit, and conferred the revenues from it upon their schools. Moreover, a Federal law of 1862 guaranteed an endowment in land to whoever should found a college.

Some endowments have amounted to considerable sums. The report of Mr. Eaton for the year 1870–'71 contains a table of endowments made during the year in favor of institutions of instruction; the total is 43,000,000 francs, and of that number there is one endowment of 5,000,000. Great liberality is not rare; one of the men most justly celebrated for this generosity for the public benefit, Mr. Peabody, gave at several times sums to the total amount of 18,000,000 francs.

Finally, the particular State, the county, the township, imposes on itself, we might say from choice, taxes providing for the expenses of schools.

The sum total of these expenses is so significant, and discloses political habits differing so greatly from our own, that we must give some details respecting it. We take them from the report published in 1870 by Mr. Eaton, then superintendent of education in Tennessee, and report for the year 1868–'69:

Expenses of several States, expressed in millions of dollars.

States.	Expenses of public instruction.	Expenses of all other services.	Total expenses.
Maine	0.8	0.4	1.2
Pennsylvania	5.1	3.8	9.0
New Jersey	1.3	0.4	1.7
Ohio	4.8	2.9	7.7
Illinois	6.4	1.0	7.4
Wisconsin	1.7	0.9	2.7
California	1.1	0.4	1.6

The appropriation of the State of Illinois is in this respect the most astonishing. Counting the dollar only 5 francs (currency) it expended in 1869 a total of 37,000,000 francs, 32,000,000 for public instruction. In 1865, the expense of instruction was 16,000,000; in 1870, it was 40,000,000; in this last amount is comprised the revenue from the school property, of which the landed value is estimated at 84,000,000 of francs, and the revenue from the school funds, the capital of which is 31,000,000. It is a population of two and a half millions that expends this sum; consequently, the average is 16 francs per head of the inhabitants. This report is for 693,000 pupils, (primary, secondary, and higher instruction;) consequently, about 60 francs per pupil.

Without attaining this proportion, the other States of the North and West are remarkable for the magnitude of the expenditure per head of inhabitant or of scholars. New York, with less than four and a half millions of inhabitants and one million scholars, expends 50,000,000 francs. Mr. Hippeau, in his book on public instruction in the United States, estimated at 450,000,000 the sum annually expended for public schools in the Union. The census of 1870 gives about 500,000,000, ($95,500,000;) this was a proportion of more than 12 francs per inhabitant.

212. In the West the school-houses are, in general, pleasant cottages; in the rural districts of the East, pretty houses, covered with vines; in the cities, great buildings five stories high, with audience-chamber, library, and collection. In each of the school-houses there is at least one piano. The United States built a rural school-house in the park of the Exhibition at Vienna. The building was divided into two parts, the class-room and another apartment. The school-room, arranged for forty scholars and well lighted, had two entrances, one for the boys and the other for the girls; each sex occupying one of the sides of the room, for in the United States the instruction is given to the two sexes in common, the Americans seeing in this mingling a cause of emulation and a means of education. Each pupil has his desk and his seat. The elegance of the furniture, of which various specimens adorned the interior of this building, gave an idea of the munificence of the Americans to their schools.

School-houses are very numerous. Thus, while in France in 1872 it was estimated that there was less than one primary school, public or private, for 500 inhabitants, in New York are reckoned one primary or secondary school for each 300 inhabitants, one for 270 in Massachusetts, one for 160 in Ohio, one for 130 in Wisconsin; an average for the United States of one school of some sort for 280 inhabitants. It is just to add that the scattered settlements of the inhabitants make more schools necessary to obtain an equal result, and that in the very States that we have cited the proportional number is in inverse ratio to the density of the population.

213. The United States also expend a great deal for salaries of teach-

ers. In New York the principal of one school receives 7,750 francs; in Philadelphia, 9,000 francs; in San Francisco, as much as 12,500 francs. In the villages of Massachusetts the monthly pay is 250 francs for a male teacher, 115 for a female. However, we need not be deceived by these figures, for the cost of living is much greater in America than in Europe, and salaries there are, as a general rule, much larger. Recently the superintendent of Bridgewater* complained of the scantiness of the pay at a time when all salaries were rising. "Will they leave us," said he, "Will they leave us teachers to seek some other career and let instruction be given by ordinary men?" He cited the fact that the best teachers came from the mills of Lowell and Lawrence, and meantime the pay of a workwoman at Lowell was almost double that of a teacher, who received $5.20 (about 26 francs) per week, and who paid $2.50 (about 13 francs) for food and lodging.

214. Teaching is not in America, as it is in Europe, a permanent pursuit, a career on which one enters for life. Teachers are appointed only for a single year, for six months even in the country schools, where the school is held only six months. They pass not only from one school to another, but from teaching to some other business, with the greatest facility. As what we may call workers find usually plenty of lucrative employment, it is difficult to retain them, and they do not appear to become much attached to any particular business. In the cities especially, women are preferred, because they demand less pay, are more reliable, and almost always better educated. In 1868 Connecticut contained 2,057 female to 150 male teachers; New York, 21,218 female to 5,271 male; Philadelphia, 1,112 female to 82 male. The United States estimated, after the general census of 1870, there were 93,329 male to 127,713 female teachers. The women themselves do not generally look upon teaching as a definitive career; they engage in it, on an average, for five or six years, and then leave it and marry. Society thus gains mothers who are more capable of raising children, if they will take that trouble. The school does not gain by it; and whatever may be said, it is certain that this facility of change has more of disadvantage than of benefit to teaching.

In order to form good teachers who will remain such, normal schools have been established. The first, that of Lexington, Mass., dates from 1840. To-day Massachusetts has four, and all the States possess at least one; many of them are simple appendages to high schools. The course is two years.

215. The people of the United States are not satisfied with the attendance of their schools. "More than half of the children of the age required for their admission into the schools, have not attended them," said, in 1858, the report of Connecticut, and many of the superintendents say the same. It is true that the Americans understand by school-age more than we generally understand from the word in Europe. In

* Twenty-eighth annual report of board of education, (Massachusetts,) p. 261.

California the school-age is 5 to 15 years; in Vermont 4 to 18; in Kentucky 6 to 20; in New Hampshire 4 to 21; in Alabama, Arkansas, and New York 5 to 21. Now the greater part of the boys leave school for active life between 14 and 15; the girls remain more frequently to the ages of 15 and 18. This is one of the reasons on account of which there is everywhere a notable deficit. In Connecticut, out of 125,000 children and youth of the school-age, there were 110,000 on the roll, and 62,000 present; in Illinois these numbers were 862,000, 652,000, and 339,000; in Iowa 460,000, 341,000, and 212,000.

In order to prevent absences, many Americans claim that it is the duty of the parents to send the children to school. "If we take the money of the citizens for the purpose of instructing all the children, they ought to receive instruction, without which taxes are no longer justifiable," said the superintendent of Ohio. This obligation exists in a certain number of States. In Massachusetts, which is in some sort the Attica of the United States, a law was passed in 1850 empowering the authorities to prosecute the children who did not attend school; another law in 1862 obliged all the authorities to take measures of this nature, and to constrain, under penalty, all parents to send their children to school between the ages of seven and sixteen years. Connecticut, by the law of 1858, authorized the justices of the peace to take the children from the parents who should neglect their duty in this respect, and to intrust them to capable masters, the girls till they were eighteen, the boys till they were twenty-one. Rhode Island and the two Carolinas and Arkansas have recently passed similar laws.

But the idea of obligation is so opposed to the American character that few of the States outside of New England, peopled as it is by the old Puritans, have as yet adopted it. The obligation which they accept willingly is that there shall be schools in every community. The State can bring an action against any township which does not have a sufficient number of schools, while on his side the father of a family whose children cannot find a place in the school can bring an action against the township. Between the two, the township is forced to do its duty. The township, or rather the committee appointed and commissioned by the township, is responsible for the administration of the school properties, and the oversight of the schools; besides which each school has its managing committee, also elective. In each State a board of education or board of commissioners, presided over by a superintendent of education, who is one of the most important officers in the State, superintends the townships and appoints the teachers, but has no other very definite authority. This system is not perfect; the machinery does not always work well, and power and money are sometimes misused. Several States seek to place too much authority in the hands of the superintendent.

As we have said, each State makes its own rules and laws relative to education. When in 1867, after the slavery war, it being desirable to

make a report of the state of education, and so become able to follow its progress, Congress created at Washington a department of public instruction; this bureau furnished information and made inquiries, but exercised no authority.

216. The South is less advanced than the North and West in respect to public instruction. In 1870, according to the census, there were, out of 33,500,000 whites, 1,871,000 illiterate, above the age of twenty; out of 4,890,000 blacks, there were 1,765,000. Now, as the adult population forms scarcely half of the total population, we may say that 68 per cent. of the adult blacks could neither read nor write.

Congress was not afraid to proceed against this public danger, and private citizens assisted. In 1862 several associations were founded for the education of the blacks, and 1,500 schools were opened. Congress gave a sum of 45,000,000 of francs to the Freedmen's Bureau, and in 1868, 4,000 schools were established for the blacks. In the new constitution of 1868 Arkansas expressed herself thus: "The diffusion of knowledge among all classes being essential to the preservation of liberty and public rights, the legislature is bound to establish a general system of free schools, so that all persons between five and twenty-one can have access to them; all children shall be obliged to attend these schools at least for three years, excepting those who are taught at home." In 1870, out of 182,000 inhabitants between the ages of five and twenty-one, Arkansas had 107,000 in school. The success was not by any means so great everywhere. In Texas, in 1871, the free schools opened for the blacks were burned and the teachers shot.*

In 1870 the general census gave the following returns: 141,629 schools of all kinds; 221,042 teachers and professors, of both sexes; 7,209,938 pupils, 3,621,996 of them boys, 3,587,942 girls. The proportion is 18 scholars to each 100 inhabitants; but we must remember that this includes schools of all grades, and that we should not be far from the relative proportion of primary instruction if we call it 17 per cent. The same census showed that, of persons above ten, the population of the United States included 4,258,000 illiterates, perhaps 11 per cent.† Four-fifths of the illiterate persons belonged to the Southern States.

Illinois, Indiana, and Ohio rank first; they are said to have 30 per 100 inhabitants in the schools, which is probably not correct; and Nevada and Maryland rank lowest, showing 6 per 100. These figures seem to show the imperfection of the statistics rather than the true state of things.

217. In recognition of these immense efforts and these important results, the jury awarded a diploma of honor to the national Bureau of Education at Washington, desiring thus to testify to the whole Union

* And meanwhile, near Texas in the Indian Territory, the Cherokees, Chickasaws, and Choctaws maintained schools which more than 5,000 children attended.

† France in 1872 contained 30 illiterates for each 100 inhabitants who had completed the fifth year.

their sympathy with the friends of learning. They also awarded diplomas of honor to the government of Massachusetts, and to the city of Boston, in order to honor more particularly the State and the city which are the center of literary culture in America. They also accorded one to the Smithsonian Institution, to-day so well known all over the world for the zeal and liberality with which it serves the interests of science and aids the progress of instruction.

218. SECONDARY INSTRUCTION.—Between primary and secondary instruction the limit is not clearly defined in the United States, and the official statistics make no distinction.

The grammar-school in which Latin is taught has, as it were, one foot in secondary teaching. Often, after the regular course of four or five years, these schools have a supplementary course of two years, to which scholars are admitted after examination, and which constitute one sort of industrial school.

On leaving the grammar-school, the pupil who wishes to continue his studies enters, when about fourteen or fifteen, the high school. In the large cities of the East, there are English high schools, having usually four classes, and Latin high schools having six classes. The first correspond to industrial teaching, the second to a particular sort of classical instruction. In the cities of the Middle and of the Western States, the high school is at the same time both industrial and classical, the pupils choosing whichever course best suits them. The high schools are numerous, well maintained, and usually well endowed. Every city having at least five hundred families is required to have one, and some of the villages have them. Most of the teachers also come from these schools. In the system of education of the United States, such at least as is adopted by the Northern States, they form the highest grade of public schools, free to all, and liberally endowed from the revenues of the States. Beyond this the course is left almost free to the scholar, the community no longer interfering, unless in exceptional cases. But private industry, and above all the liberality of wealthy citizens, who are never wanting, provide for their wants in a great measure.

There are some private high schools, but they are usually less frequented than the public schools of the same grade.

The contrary is true of the academies, which form the intermediate degree between the high school and the college. In these are taught arithmetic, grammar, history, geography, ancient and modern languages, sciences, mathematics and physics, moral science, and among the rest political economy, a study too much neglected in France. Young girls are found there in almost as great number as boys. These are usually private institutions, some entirely free, and others having a charter of incorporation and receiving assistance from the State or from the community. Massachusetts, in 1864, possessed 670 academies, of which 59 were incorporated, containing in all nearly 19,300 pupils. In 1868, New York had 445 academies. The total number of these establishments may be estimated at more than 10,000.

Then come the colleges, which lead directly to the higher instruction of the universities. The colleges give classical instruction, and several are, at the same time, college and university. M. Hippeau estimated, for the year 1869, the number of colleges and universities of the Union at 290, only 90 of which were founded and endowed by the States, and the number of students as from 70,000 to 80,000. "It is not," said M Hippeau, "in the heart of populous cities, it is more frequently in their neighborhood, in the midst of smiling and fertile fields, that colleges are established, where the pupils can breathe pure air, and walk freely beside the brooks or in the avenues formed around the college by beautiful and venerable trees. Their organization reminds one somewhat of the English colleges. The outfit is generally very liberal, and they apply it to beautiful collections and a rich library. Yale College has a library of 119,000.* Some of these establishments, university and college together, contain, like Michigan University and Oberlin College, Ohio, more that 1,000 pupils; Harvard College, at Cambridge, has about 500 pupils."

219. There are large colleges which are designed solely for young women; for example, the Packer Collegiate Institute, of Brooklyn, and Vassar College, Poughkeepsie. There are others, as Oberlin College and the establishments of instruction of Chicago, where young men and young women pursue, in common, the same studies. It has not been remarked that the latter exhibit any inferiority to the former; there is, in fact, no reason to believe that the intellect of woman is any less adapted to the sort of development given by literary instruction, than that of man.

Oberlin College, founded in 1833, is a kind of university, containing more than 1,200 pupils; it has a male principal for the young men, and a female principal for the young women. It contains 11 pupils in the theological department; 117 pupils, of whom 9 are females, in the classical college, where their course is four years; 120 girls in the special classical course, which also is four years; 34 pupils in the scientific divisions, the course is three years; 698 pupils in the preparatory divisions. Not far from the class-room building is the Ladies' Hall, a boarding-house, in which are accommodated 100 girls, each having a separate room, and the refectory, in which 200 girls take meals. In addition there is the Tappan Hall, a boarding-house of the same description for young men. The other students, of both sexes, are lodged among the families in the village.

220. OBJECTS EXHIBITED.—In the school building that they constructed, and in the gallery of the Industrial Palace, the United States exhibited their material of instruction.

First are the numerous public reports, either by the National Bureau of Education, to which was committed the organization of this portion of the Exhibition, or by the different States, principally by Connecticut;

* M. Hippeau, p. 206; also p. 202, 60,000 volumes.

by Massachusetts, whose collection from 1837 to 1872 forms 22 volumes; by the city of Boston, whose collection, forming 16 volumes, was prepared by the efforts of Mr. Philbrick, superintendent of education at Boston, and by the city of New York. In the second place, the reports and publications of the colleges and universities, catalogues of libraries, and a large collection of journals. In the third place, the maps and works on geography, of which we will speak in another report; the classical books, of which the principal publishers are Harper Brothers, of New York, one of the largest publishing houses in America; Barnes, of New York; Ivison, Blakeman, Taylor & Co., of New York and Chicago; Collins & Brothers, of New York; Wilson, Hinkle & Co., of Cincinnati; the Appletons, noted especially for their scientific publications; Scribner, of New York; Brewer, of Boston, and Lippincott, of Philadelphia. American books commend themselves in general by their elegance and clear type.

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221. GEOGRAPHY—ATLASES.—The United States have several large atlases, among others that of Colton, and that of Johnson; these works are more complete than elegant; the coloring is heavy. There are better engravings in the atlas of Pennsylvania, by Welling & Gray, than in the school atlases. Among the latter we must mention those of Guyot, Warren, Mitchell, Steinwehr, and Cornell, which received awards. These atlases, forming so many series, divided into three or four volumes, primary-school, grammar-school, high-school, and physical geography, consist of maps interspersed throughout the illustrated text, forming at once a book and an atlas. They are all derived from the type of Mr. Arnold Guyot. This scholar, whose last work, "Atlas and Physical Geography," recalls worthily his first work, "Earth and Man," felt that geography needed to be comprehended rather than merely apprehended; so he has sought to give intelligence of the great laws of nature to his pupils, and thus to inspire a perception of the harmony which presided over the arrangement of the world. Rendering the instruction elevated and interesting by comprehensive views, and at the same time simple and accessible to children, he became the creator of a fruitful method.

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222. MURAL CHARTS.—I close this review with the United States. Here again we find M. Guyot, who accomplished in mural cartography the same revolution as in the rest of geographical instruction. He endeavored especially to demonstrate the leading features of physical geography, streams, plains, declivities, plateaus, and high mountain chains, and employed mainly green and brown, reserving white for the highest peaks. His planisphere, his North America, and especially his United States, which have all the merit of his atlases transformed into the mural style, are very skillfully executed. The other mural charts presented by the United States were inferior, the charts of particular States having none of the qualities proper to mural charts.

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223. GLOBES.—The United States exhibited many globes, because, in a country where the full importance of teaching by sight is understood, and where money is freely spent on the schools, globes are very widely distributed. Those which were exhibited were distinguished by nothing original. We sought in vain for globes with iron frameworks, which are very costly, but by the aid of which a class of children can be made to comprehend, by placing on them magnetic miniature men, like men living on the earth, in the southern as well as in the northern hemisphere. Globes of several dimensions, made by Schelder, of New Jersey, which received awards, appeared to us to possess, in a greater degree than the others, the merit of clearness and convenient mounting.

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224. BOOKS AND METHODS.—The United States in their programmes assign to geography a very different place in different States. In the primary schools of Boston it is nowhere mentioned, but in the grammar-schools it is taught three years in a course of four years, from Warren's books. In the Latin school, geography is taught but two years out of six. In the programme of study for Harvard College it has no place; but at New Bedford, in the same State, they give much more attention to this subject; and at Chicago, in a primary course of six degrees, geography is represented in five, and the drawing of maps is specially recommended.

The method most followed, or at least the most original, is that of Mr. Arnold Guyot. It is founded, like the method which is becoming popular in this community, on the facility with which children can comprehend and retain by sight; it avoids abstract definitions and names, and turns to account scenes of nature, tempests, cascades, passage of forests, the labors of man, such as the chase and husbandry, or the elementary laws of physical geography, wind and winter; it interests by pictures, which the master describes, without necessarily describing the surrounding country. These two methods are rational, and far preferable to those which consist in learning by heart in the beginning a long series of abstract definitions of geographical terms, and long lists of proper names of seas, islands, cities, &c., without comment. If we add to this what al geographical authors censure, but what some practice—that this latter system does not employ maps—we can see that thus geography, which is in itself attractive, might be made the dullest and most useless of studies.

EXTRACTS

FROM

GERMAN REPORTS

RELATING TO THE

EXHIBITS FROM THE UNITED STATES

AT THE

INTERNATIONAL EXHIBITION, VIENNA, 1873.

TRANSLATED BY

A. SORGÉ, M. E.,

UNDER THE SUPERVISION OF THE EDITOR.

REPORTS TO THE CENTRAL COMMISSION OF THE GERMAN EMPIRE.

GROUP I.

MINING, QUARRYING, METALLURGY.

Section 3.—Fabrication of iron and steel.

Report of Messrs. Dr. Lerlo and Dr. E. Stölzel.

225. Machinery.—Wm. Sellers & Co., of Philadelphia, exhibited the model of a very neatly-made train of rolls. In this train one of the rolls is movable, and is made to approach the other to any required degree, by means of hydraulic pressure, the object being to diminish the number of grooves, by using the same one several times.

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226. Nickel and cobalt.—Since the last Universal Exhibition the field of application of *nickel* has been further extended by new applications of its valuable properties, its beautiful color, its resistance to the oxidizing influence of the atmosphere, and its hardness. The German Empire has joined other states in using coins made of an alloy of copper and nickel; (Switzerland from 1850, the United States from 1856, Belgium from 1860.) An increased consumption has been a consequence of the widely-extended practice of nickel-plating other metals. This exhibition has several examples of the application of this process; among others, the tramway cars exhibited by John Stephenson & Co. in the United States section, Group XIII, the metallic parts of which, the handles, &c., were beautifully nickel-plated. An altogether novel application of nickel is that for axles, axle-bearings, and other parts of machines, as shown among the American exhibits, and for which nickel seems to possess peculiarly excellent qualities. A small axle-bearing of nickel, exhibited by Wharton, of Philadelphia, still shows evident tool-marks and scarcely perceptible wear, in spite of its having been in use four years.

In consequence of this, an enormous rise has taken place in the price of this material. The manufacturers of German silver, particularly, feel this severely, and it may be expected that, in future, the discovery and mining of nickel ores will receive greater attention.

GROUP II.

FORESTRY AND AGRICULTURE.

FORESTRY.

Report by Oberforstrath Dr. Indeich.

227. United States of America.—It might certainly have been expected that America would produce an exhibition corresponding to some extent to that of its forest products; but in reality that which was shown was very unimportant, in spite of the richness of the country in these products. We need only mention a small collection of useful timber from the State of Indiana, exhibited by Prof. E. T. Cox, of Indianapolis, and a similar one of sawn timber by Stewart & Kirkland, of Jackson, Miss. An important, though minor product of those forests is a lichen, the tree-moss, (*Tillandsia usneoides*,) which is exhibited by two New Orleans firms, I. Raymond and I. Rykaski. It is in large quantities, both raw or worked. The lichen closely resembles our domestic *Usnea*, as is indicated by the name. It is submitted to a process of baking, by which the greenish-gray skin is removed. The remainder is dried and used as a material for upholstering, and resembling, in exterior appearance, the hair of animals. It is very probable that this tree-moss will be a competitor in the market with our so-called seaweed.

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228. Agriculture—Agricultural implements.—North America exhibits a great number of mowing-machines of various constructions, which greatly surpass in elegance those of all other countries.

Not only do we find in these machines polished wood and elegantly lacquered castings, but also silver-plated and nickel-plated parts of wrought iron, while the construction of the machine is the same as that of ordinary machines.

The manufacturers lay themselves open to criticism by this unusually elegant finish, which gives their machines too favorable an appearance, and some of the exhibitors have, therefore, placed standard working machines beside those which are silver-plated and polished. In our opinion, all machines should be fitted out for an exhibition more elegantly than usual, for the greater number of visitors know very little about machinery, and would, therefore, be impressed unfavorably by seeing the machines in their working-dress, beside the other objects of the exhibition, which are brightly adorned. At the same time, the expert visitor can easily perceive the real merit of the machine in spite of this beautiful finish.

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229. The American mowing-machines which were exhibited are all arranged in such a manner that they work with as little lateral motion

as possible. But since this is not possible with a fixed shaft, with a variable position of the grain, and even ground, therefore the combined Champion machine of Warder & Mitchell has an arrangement for shifting slightly either to the right or to the left. This simple arrangement is specially necessary for combined machines with different widths of cut for grass and grain. The English machines, which had as much lateral motion as possible, at Paris, are, to a great extent, still somewhat encumbered by it.

A great step in advance is the use of seats on the machines for the drivers, for the driver can only see the horses and the machine at the same time from a seat. The use of seats also facilitates the working of the machine, since the machine can be so balanced by it that the horses no longer bear the weight of the shaft, and both horses are therefore equally employed.

The Americans have very many combined mowing-machines, all with two wheels, except the Kirby, while all grain-mowing machines have one driving-wheel.

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GROUP III.

CHEMICAL INDUSTRY.

Report by Prof. Dr. A. W. Hofmann.

230. Magnesium.—Magnesium is only manufactured on a large scale by two establishments, the American Magnesium Company, at Boston, United States, and the Magnesium Metal Company, at Manchester, Great Britain, which latter is in charge of Mr. Mellor. The English manufactory produces about 45 cwt. annually, and the American about 30 cwt. The former furnished large quantities for the English army during the campaign against King Theodore, of Abyssinia, the metal being employed extensively for signals.

Magnesium can readily be ignited at the flame of a candle. Combustion is frequently interrupted by the dropping off of the burning portion, so that it becomes necessary to feed the unburnt portion into the flame continually. The wire burns to the best advantage if it is inclined at an angle of 45°.

231. An uninterrupted and very brilliant combustion is produced by lamps especially constructed for this purpose. Such a lamp* is made by the American Magnesium Company. The strips of magnesium are rolled up on cylinders in the upper part of the apparatus. These strips are unrolled by clock-work in the lower part of the apparatus, and are carried between two small rollers, the uniform motion of which feeds them regularly into the lamp, where they are ignited. The ashes are cut off at intervals by means of eccentric cutters, and collect in the bottom of the apparatus. A small chimney is added, which is very important, as producing a draught of air directly through the flame. A portion of the products of combustion is thus carried away, and the flame becomes very intense, while it is less so without a draught. This lamp has been found very efficient, especially for marine signals. At trials made at sea, on two vessels stationed eight miles apart, the signals could be readily distinguished.

Mr. Larkin has constructed and patented a lamp based on a different principle. The magnesium is not employed as wire, or in strips, but as a powder. By this means the clock-work, or other mechanical device, has been dispensed with. The metallic powder is contained in a reservoir, which has a small opening in the bottom. The magnesium powder flows through this like the sand in a sand-clock. It is intimately mixed with a certain quantity of fine sand, in a manner diluted; first, in order to be able to make the opening sufficiently large; furthermore, to produce a continuous flow of the material. The mixture falls into a metal-

* From designs patented by R. H Thurston, 1865. New Marine Signal Light: Journal Franklin Institute, 1866.—Trans.

lic tube, through which illuminating gas is led from the upper end. The mixture is ignited at the lower end. The flame is very brilliant, and the remaining sand falls into a vessel placed below, while the smoke passes away through a chimney.

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232. ALUMINIUM AND ITS ALLOYS.—Mr. Fleury, of Boston, reduces aluminium from clay, which he mixes with coal-tar, resin, petroleum, and similar substances, to the consistency of dough. This paste is made into balls and dried, and is then treated in a red-hot tube with hydrocarbons, under a pressure of from twenty to thirty pounds per square inch. The spongy aluminium is fused with zinc, and the latter is afterward driven off by sublimation.

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233. CRYOLITE FROM GREENLAND, ETC.—We see, from the table, that the number of ships and cargoes has increased materially since this article found a market in America, in 1865. America is much better situated for such voyages than Europe. On the other hand, America, which usually sent old wooden ships, had very many wrecks, and experienced much damage by sea, seven wrecks and two damaged cargoes between 1865 and 1871, while Europe had only one wreck in the same time, in 1871.

Taking the Danish ton at 6 cwt., we have 1,359,667 cwt., or, since 20 cwt. equal one ton, 68,000 tons.

We see, also, from the table, that America received by far the greater portion of the annual production, except in 1873. The reason for this is that the contract states that America shall receive 6,000 tons annually, while Europe can only get 4,000 tons. If we base our calculation upon this fact, we obtain a greater export of cryolite. America received 6,000 tons annually during nine years since 1865, except in 1873, when it could only get 2,000 tons, on account of unfavorable conditions of navigation; this makes 50,000 tons for America and 36,000 tons for Europe. Adding to this the former exports, we find the sum total to be 100,000 tons. The state of Denmark received more than 500,000 rigsdaler from this source.

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Cryolite has also been used for the manufacture of glass in America. An extensive establishment, the Hot-Cast Porcelain Company, has been organized for this production. A milk-white, somewhat translucent glass is made from pure cryolite, and a uniformly colored or marbled variety of opaque glass is made from impure cryolite. The mixture for the milky variety is: 1 part of oxide of zinc, 4 parts of cryolite, and 10 parts of sand-ore, fused in a common pipe-clay crucible, developing a large amount of fluosilicic acid. The pipe-clay is, however, not attacked much by it. This development continues throughout the fusion, and even after it, during the working to a small extent. This glass possesses a considerable hardness and power of resistance; even as a pow-

der it is not attacked by strong acids. According to an analysis of Mr. Hagemann the composition is as follows:

	Per cent.
Oxide of zinc	6.50
Silicic acid	63.40
Alumina	3.67
Soda	5.85
Oxide of iron and manganese	4.40
Undecomposed cryolite	15.14

(According to two analyses.)

The properties of this glass probably depend upon the presence of the undecomposed cryolite; for glass of the above composition, without any combinations of fluorine, is transparent and not colored. Glass with a small amount of cryolite has a milky-white, translucent color, and great brilliancy, refractive power, and strength. With a higher proportion it becomes opalescent, and with more cryolite, opaque and like porcelain.

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234. PRODUCTION OF WROUGHT IRON.— * * * Rogers,* of Newark, N. J., employs a method which consists of reducing the magnetic iron-ore with coal in from five to eight hours to a spongy iron, in a cylinder 16 to 20 feet high and 6 feet in diameter. Every half-hour from 110 to 130 pounds are drawn into a puddling furnace and are there worked into a bloom; it is necessary to have a sufficient quantity of fused slag in the furnace.

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235. ZINC AND CADMIUM.—The production of zinc in the United States of North America amounted to 7,000 tons of crude zinc and 3,000 tons of rolled zinc in 1873, being produced directly at the mines, besides the additional amount of 6,000 tons of zinc-white.

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236. PRODUCTION OF SILVER.—Unlike gold, the production of which has been materially increased within the last twenty-five years by its abundant occurrence in California and Australia, the production of silver has been limited to the old localities, having risen at some and fallen at others. The value of the production of silver for the year 1868 has been estimated as follows:

	Thaler.	Dollars.
Mexico	30,000,000	25,000,000
Chili	7,600,000	6,384,000
Peru	5,480,000	4,603,000
Australia	4,900,000	4,116,000
Germany	4,000,000	3,360,000
France	2,100,000	1,764,000
Great Britain	1,620,000	1,360,000
Russia	1,500,000	1,260,000

*See Scientific American, VI, No. 15.

Making a sum total of 60,000,000 thaler, ($50,000,000,) while the amount of gold produced in 1869 is estimated at 400,000,000 thaler, ($336,000,000.)

The Cordilleras of America contain, in numerous localities, quantities of the precious metals, which have made the wealth in silver of Mexico and Peru proverbial. The Spaniards have mined these metals since the sixteenth century. While Mexico still retains the first place, the mines of Peru, as Potosi and Cerro de Pasco, have failed, on account of political disturbances, and have been surpassed by those of Chili, which are situated in the northern unfertile provinces, (Coquimbo, Atacama,) and which also contain a great wealth of copper. The existence of these metals has been more or less well known in all of these regions, while the same cannot be said of the Western Territories of the Union, where silver has lately been found in promising quantities, and has been scientifically examined. While mercury, tin, and chrome ores are found in the mountain-ranges along the sea-coast, the next parallel chains to the east, the Sierra Nevada and Oregon Cascades, contain two zones on their western slope: at the foot, a series of beds of copper-ores, and at about the middle of their height, strata containing gold. These, and auriferous veins, run far northward to Alaska. On the eastern slope of this large chain of mountains, beds of silver-ores are frequently found in volcanic rocks, and extending southward to the Mexican mines. Another series of such beds of silver runs from Central Mexico through Arizona, Nevada, and the interior of Idaho, occurring generally in rocks of older formation. A belt of argentiferous-galena deposits runs through New Mexico, Utah, and Western Montana, and, as does a series of gold-beds, passes eastward from the south of Colorado through Wyoming and Montana.

A portion of these vast regions has been examined topographically and geognostically within the last few years, and the results are contained in official reports published by the Government of the United States.

We will now only refer to the silver-ores of the Washoe district, which have been mined since 1860, and consist of native silver and galena, which generally do not contain visible gold, while the prevailing rock is quartz. According to their composition, they are divided into three classes. The first class is roasted with salt in a reverberatory furnace after dry pulverization and grinding, and is then submitted to amalgamation in casks, while the other classes are worked by the so-called Washoe process, a kind of amalgamation in pots or pans, with the addition of chemical re-agents consisting of salt or blue vitriol, or both. In order to determine the various reactions which take place in this process, experiments have been made at the laboratory of Yale College, with small quantities of ore, (twenty pounds.) It was mixed with water to a paste, which was heated by steam; then blue vitriol and salt were added in the proportion of one to two, and finally mercury; the whole

mass was then agitated. The amalgam which collected in the vessel was distilled and the gold and silver were separated by nitric acid. The results of these experiments, based upon the principle of the American method of amalgamation, seem to have been very different for different kinds of ore. They have induced the American author to review the theory of this amalgamation, which led to various opinions at the time. But the experience at Washoe itself, as well as the above-mentioned experiments, show, evidently, that the addition of the magistral to these ores can frequently be dispensed with, and that the extraction of silver by mercury alone is in no way reduced.

The American author is inclined to attribute great influence to the iron in this amalgamation with pots or pans; it decomposes chloride of silver, and chlorite of mercury, and accelerates the decomposition of sulphide of silver in contact with mercury. In fact, not only the surface of the pans, but the iron in the ore, which comes from the stamps, must be considered as acting in this manner. But if chloride of copper is not essential in the Washoe process, it seems to us to indicate the presence of a large portion of native silver.

A crystallized amalgam, which was produced accidentally in the course of the operation, contained 75.04 per cent. of mercury, 24.18 per cent. of silver, 0.77 per cent. of gold; it was, therefore, either $Ag_5 Hg_7$ or $Ag_2 Hg_3$.

These facts, again, show that the reactions in the American process of amalgamation are not yet as clear as could be desired. It is enough to remember that the theory of Sonnenschmidt, Rarsten, and Boussingault is based upon—

$$2\,Cu\,Cl_2 + Ag_2\,S = 2\,Ag\,Cl + 2\,Cu\,Cl\,S,$$
$$2\,Cu\,Cl + Ag_2\,S = 2\,Ag\,Cl + Cu_2\,S;$$

while Bowring completely denies the formation of chloride of silver, and claims that the oxychloride $Cu_2 Cl_2 O$ is formed from chlorite of copper by the influence of the air, giving

$$3\,Cu_2\,Cl_2\,O + Ag_2\,S + H_2\,O = 2\,Ag + 3\,Cu\,Cl + H_2\,S\,O_4;$$

that is to say, chlorite of copper is formed by the side of free sulphuric acid!

If we cast a glance at the present methods of extracting silver, we find that the amalgamation which Bartolomeo de Medina introduced in America in the middle of the sixteenth century, and which had been introduced in a modified form in Europe at the end of the last century, (Hungary, Freiberg, Mansfeld,) has disappeared again from the latter locality and is limited to America, where it could not be replaced by any other process on account of local conditions. The ancient and, theoretically, very interesting Saiger process has been abandoned, and methods of extraction have been introduced, which either have for their object the formation of chloride of silver, and its extraction by means of a solution of salt, (Augustin's process,) or which consist in

carefully roasting the sulphur metals, forming and again decomposing the sulphates of iron and copper, leaving the sulphate of silver, which is extracted by means of water, (Ziervogel's process.)

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NEW SOURCES OF RAW MATERIALS FOR CHEMICAL INDUSTRY.

237. EMERY AND CORUNDUM.—Dr. Charles Jackson found a bed of emery in the crystalline schists at Chester, Hampden County, Massachusetts. On an average it is 1.3 meters (4 feet 3 inches) thick, but sometimes as much as 3 meters, (10 feet.) Its occurrence resembles that at Naxos very nearly, and the adjacent minerals are the same; titaniferous magnetic iron and corundum occur extensively. According to Daubrée, the production supplies the demand of the United States, and its export has increased considerably since 1873. (Emery-wheels of the Tanite Company.)

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238. IRON AND IRON ORES—PRODUCTION OF IRON.—The production of iron, as estimated for 1867, was 105,000,000 cwt. for Great Britain; 25,500,000 cwt. for France; 7,000,000 cwt. for Austria; 9,000,000 cwt. for Belgium; the German Customs Union produced 27,800,000 cwt. in 1870 and 14,500,000 cwt. in 1867; the total production of pig-iron for the United States of North America was 39,000,000 cwt. in 1869. Hewitt estimates the total production of iron on the earth at 200,000,000 cwt. annually.

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239. NICKEL.—The most important nickel-mine of North America is said to be that of La Motte, in Missouri. The ore of cobalt and nickel found there contains 30 per cent. of nickel, according to Genth. The Camden Nickel Works (New Jersey) produce over 150,000 pounds of pure nickel from nickeliferous magnetite and iron pyrites with some nickel pyrites, obtained mainly from the Gap Mine, Lancaster County, Pennsylvania.

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240. COPPER.—Wagner estimates the production of copper in Europe and America for 1868 at 1,800,000 cwt., a great part of which is obtained from ores from the Ural, from Australia, and Chili. The North American copper-ores are found at Lake Superior, in California, Arizona, Nevada, Colorado, and Sonora. The mines of California are situated mainly at and about Copperopolis, Calaveras County; at Plumas, Del Norte, and Los Angeles Counties.

241. SILVER.—New silver-mines were discovered at Caracoles, Bolivia, in April, 1870.

According to Raymond, Nevada produced $22,000,000 worth of silver in 1870; Idaho, $1,000,000 worth. Silver-ores have also been found in Colorado, Utah, Arizona, and Montana. This belt stretches from Sonora to Chihuahua, Mexico, through the whole eastern portion of the

United States. The greatest wealth of silver, which is remarkable in itself, belongs to the Comstock mines, Washoe, Nevada; this series of veins occurs in similar rocks of later volcanic origin, as in Schemnitz, Felsöbanya, Mexico, &c.; and, according to von Richthofen, it furnished $11,250,000 worth of silver in 1865, and $4,750,000 worth of gold. Quartz, with a little lime, is the only accompanying rock; the ores consist mainly of argentite and stephanite and argentiferous galena. The production in the States west of Missouri amounted to $44,500,000 worth in 1873.

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242. GOLD.—According to the newspapers, $27,750,000 worth of gold were obtained in 1873 in the States west of Missouri. In comparison with 1872, the production of precious metals in these districts has increased by $10,000,000; this increase is almost entirely due to increase of production in Nevada.

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243. DIAMONDS.—According to W. P. Blake, detached light straw-yellow diamonds are found near Cherokee Flat, Butte County, California; according to Davidson, in Arizona, with garnets and rubies; and according to Wühler, in Oregon, in the platinum sand. Diamonds are also found in Volcano, Amador County, California; and, according to Goodyear, in the pebble-beds of El Dorado County.

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244. MINERAL COAL AND LIGNITE.—Mr. H. Credner estimates the superficial extent of the North American coal-fields at about five thousand eight hundred German square miles, while Great Britain has only four hundred and eighty square miles of coal-fields. Pennsylvania, the great center of production, furnished about 16,000,000 tons of anthracite in 1870. Danbrée estimates the total shipment of the United States for 1866 at 26,000,000 tons, and it has certainly risen since then. Edw. Hull states the production of mineral coal in British North America as 1,500,000 tons.

Coal-beds of later formation have repeatedly been discovered in California; the production, of which the mines at Monte del Diablo, near San Francisco, furnished 70,500 tons in 1863, has increased materially since then. In the Territory of Washington and on Vancouver Island, coal of a later formation is mined extensively. Hull estimates the production of lignite in Chili as 1,000,000 tons in 1870, and at the same figure for Mexico in the same year.

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GROUP IV.

ARTICLES OF FOOD AND LUXURY AS THE PRODUCTS OF INDUSTRY.

Report of Prof. Dr. C. Eugene Thiel.

Section II.—*a.* Sugar.

245. United States of North America.—The consumption of sugar in North America amounted to about 460,000 tons in the year 1867, and to 600,000 tons in 1870, of which 32,000 tons were made from sorghum, corn, &c., and 2,300 tons consisted of maple-sugar. The Americans use more sugar than any other people on the earth with the single exception of the English. It has been estimated that the consumption amounted to 36 pounds per capita; it is principally used in the form of sirup. Besides the dark sirup the refineries put a white sirup into the market; this is a thick uncrystallizable product, which is greatly liked in America.

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The sugar manufactured in America only amounts to about one-eighth as much as the imports; while at least one-half of the consumption in Europe consists of beet-root sugar.

After a series of unsuccessful trials, the manufacture of beet-root sugar is beginning to be introduced in America, and will undoubtedly be successful, judging from the well-known energy and perseverance of the Americans. Since the late rebellion several beet-root sugar manufactories have come into existence in the States of Illinois and Indiana, and also in Wisconsin; all producing good sugar; it is, therefore, in great demand. Colorado has also begun to plant beets and to extract the sugar. The beneficial effects of the cultivation of the beets upon the soil and upon the feed has already attracted the attention of the cattle-feeders of Illinois.

A special branch of the manufacture of white sugar is also formed beside the production of coarse sugar, by the extraction of sugar from the colonial molasses, which has seldom been drained of it completely. In San Francisco the number of refineries has lately increased considerably. The position of the city especially favors the working of the common sugar from Honolulu and Manila. Its market is not merely in California and Oregon, but also in Peru, Mexico, and the countries on the Pacific coast of South America.

The greater part of the sugar exhibited came from New Orleans. H. Lawrence sent some very fine crystallized sugar, and P. D. Penn some beautiful, snow-white sugar, produced in vacuo, and of a sharp grain, although of a somewhat sour taste. Johnson Bradish, of New York, also sent some beautiful white sugar, distinctly crystallized. The Austrian consul, Bader, of New Orleans, brought some good, coarse sugar,

of light-yellow color and distinct grain, but evaporated over an open fire; he also exhibited some natural, reddish-brown sirup of an agreeable taste. J. John Barr & Co. exhibited some purified sirup from their refinery, and its taste was even more agreeable. Their coarse sugar, however, was yellowish, mellow, and damp. The coarse sugar of A. Dennis, of New Orleans, was much better, although it was made over an open fire; it had a yellow color like wax and a distinct grain. Gray, but excellent, sugar was brought to the Exhibition by Kennedy Patrick; this sugar was purified by sulphurous acid and lime, and evaporated over an open fire. Henriette Davidson, of New Orleans, exhibited similar gray, but spicy, sugar made over an open fire without the use of animal charcoal. A. Thompson & Co., of New Orleans, had granulated refined sugar of agreeable taste; but the cubical sugar was less excellent.

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North America produces about 30,000 tons of maple-sugar annually, and it is to be regretted that this branch was not represented at the Vienna Universal Exhibition.

Although it has not yet been possible to crystallize the sirup made from sorghum and maize, the cultivation of the sorghum (*Andropogon saccharatum*) is carried on extensively, and it is still the favorite plant of the American farmer, who contemplates with pride the results obtained within a few years in the production of sirup from this plant. These results were important in a national economic view, as they made the North more independent of the South. In the northern part of the State of Ohio alone 6,000 sorghum-presses are at work, and already 50,000,000 gallons of sorghum-sirup are made in America. This branch of industry is assisted materially by the General Government at Washington; but it is usually a secondary production of the farmers.

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MEAT.

246. Among these articles a more careful consideration must be given to the different kinds of preserved pork, as well as sausages, which are articles of food having an extensive consumption. The products of the great slaughtering establishments of the Western States of the North American Union should be mentioned first.

Two exhibitors from the above-named region exhibited hams, which were sugar-cured, before salted, then smoked with hickory and covered with cloth; thus making an article which is in great demand in North America on account of its delicious taste. These hams have, therefore, become a considerable article of trade, and are sent in large numbers to the Eastern States. The Pork Packers' Association of Cincinnati, Ohio, exhibited a graphic representation of the arrangement of, and the method of operating in, a large slaughtering establishment, and gave valuable information in regard to the extent and the statistics of this branch of industry.

This branch attained full development at the middle of the present century in the Western States; it was then supplying about one and one-half million animals. Its products soon were generally used, as the West rapidly became well settled during the last twenty years; and, as the population increased, the market extended gradually; especially as an article of food for the poorer classes. The export to Europe and to other countries has become quite considerable. Under these conditions, it became necessary to begin working on a large scale.

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In this industry a capital of over $100,000,000 is engaged. Its products have attained, especially in production of grease and lard, considerable importance as articles of export.

SECTION IV.—PRESERVES, &c.

VII.—EXTRACTS.

247. *Milk-extract*, (*condensed milk.*) Although the English and the French claim this preparation as their invention, it has now been definitely settled that to Professor Horsford, of Cambridge, Mass., United States, well known by his scientific work and his commercial preparations, belongs the honor of this discovery. In 1849 he began his experiments, trying to produce an unfermentable preparation from milk, either in the form of a pasty mass or of a powder, by adding cane-sugar and evaporating. With great disinterestedness, Professor Horsford allowed his assistant, Gail Borden, to reap the benefits of the results obtained. About 1860, the latter sold the process, which in the meanwhile had been somewhat more fully developed, to a company, which soon obtained a market for their products. Hence, the milk-extract has been known in the United States for more than twenty years. In 1866, Chamier's factory was founded, and its preparations soon became known throughout Europe by the indorsement of Liebig.

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GROUP V.

TEXTILE GOODS AND CLOTHING.

Report by Dr. Max Weigert.

248. If we watch the cotton-market, we find that the production of this excellent textile is steadily increasing. America has brought its capacity of production to a magnitude equal to that which it had attained before the rebellion, during which latter period it had been considerably reduced. It will soon exceed this amount. The ruin which was predicted as a consequence of the abolition of slavery has not been felt in the least; thus the accordance of the laws of humanity and those of national economy has been demonstrated practically in the grandest manner.

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Section II.—Cotton goods.

249. *United States of North America.*—The cotton industry of North America, under the protection of a system of duty acting almost prohibitively, has been surprisingly developed since the last war, as may be seen from the considerable consumption of cotton shown by the official reports; it is also indicated by the number of spindles, which is about 9,000,000. Assuming them to average No. 28, these give 45 pounds of thread each. It is also well known that mills exist there of an extent scarcely known in Europe. Nevertheless, the Vienna Universal Exhibition gave us little indication by which to judge of the state of this industry in that country. But few manufacturers exhibited at the Exhibition, and the wares which they produced consisted mainly of shirting and other common cotton goods. They were not calculated to attract attention or to testify to the really great importance of the American cotton industry in common grades of goods. It is also well known that their production of fine goods does not yet supply their market, and that large quantities are imported in spite of the heavy duty. There remains, no doubt, however, that the cotton industry of America has a great future before it, and its products will probably appear upon the European market at no very distant time.

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GROUP VI.

INDUSTRY OF LEATHER AND INDIA RUBBER.

SECTION I.—LEATHER; TAWED LEATHER.

REPORT OF COMMERZIENRATH CARL FRANZ DENINGER.

250. The United States are recently beginning to pay more attention to their home manufactures, assisted as they are by the barrier raised by their protective system. With the energy so characteristic in the American, they will soon succeed in driving the German product out of their market.

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Germany draws some of its supplies from the West, but generally furnishes its eastern neighbors with some kinds of materials. North America has brought large quantities of sole-leather to Europe within the last few years; but it cannot yet be said with any certainty whether this export will be regular or not. The quality of the leather, the value of the American paper money, and several other variable conditions have an influence which cannot be calculated beforehand.

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SECTION III.—INDIA RUBBER AND GUTTA PERCHA.

251. America and England, although their India-rubber industry is very important, gave but a very incomplete representation of it. The Boston Rubber-Shoe Company, with its two pairs of shoes, one pair of boots, and a telegraph-wire, covered with a layer of India rubber, afforded no means of judging of the progress of American industry in this branch.

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GROUP XI.

INDUSTRY OF PAPER.

SECTION I.—PAPER ARTICLES, PASTEBOARD, PAPER.

REPORT OF PROFESSOR DR. RUD. WEBER.

252. (B.) PAPIER-MACHÉ, CHEMICALLY-PREPARED WOOD.—Charles Watt and Hugh Burgess received a patent for a process of producing paper from finely-divided wood and waste-wood, on the 19th August, 1853, in England. In order to separate the fibers very hot lye was employed. The factory of Jessup & Moore, at Manayunk, near Philadelphia, employ this process. For a long time, the process did not give satisfaction, for it became too costly. This may probably be ascribed to defects in the apparatus for dividing up the wood in the boilers, and in the method of reclaiming the alkalies from the charred material. Nevertheless, this method of obtaining papier-maché from wood has come into use by this method of manufacture on a large scale. It only remained, therefore, to obviate the faults discovered during the process of manufacture, and thus to make this process a paying one.

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GROUP XII.

GRAPHIC ARTS.

REPORT BY GENERAL CONSUL CARL B. LORCK.

253. American book-printing is by no means a mere copy of the English; it has made its way independently. As regards the building of presses, stereotypy, type-casting, &c., America has paid off the debt it owed its mother country, with interest, and the latter has frequently adopted the inventions of its offspring. We need only mention the large printing-presses for newspapers with cylindrical stereotype-plates, and, more recently, those for endless web, as well as automatic machines for type-casting. On account of the great extent of the newspaper and job-printing business in North America, inventions and improvements concentrate almost exclusively upon such arrangements as may assist these branches. No country can produce printed matter as legible and apparently as clear as America, in spite of the small shanks of the letters. The variety of type for job-printing, especially manuscript type, in America surpasses that of England greatly, and therefore American and German type-founderies are in frequent communication, especially exchanging matrices. In general, we may say that a more purely Germanic style is usual in American printing. A book, printed with antique type in Germany, resembles an American one more than it does one from England or France. The American works have not the strictly puritanical character of the English, and the German feels more at home with them.

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SECTION I.—TYPOGRAPHY, &C., LITHOGRAPHY.

254. (C.) THE ENGLISH-AMERICAN GROUP.—We regret very much that the preparation of the report relating to the third very important group will require so little labor, and that the very small part taken by England and America at this Exhibition absolutely prevents a comparison of their capacities in the three great groups. To form an opinion from the facts that have otherwise come to our knowledge would not be justifiable; we must, therefore, be satisfied with a short description of what was presented; and we cannot draw any other conclusion than that it was not found necessary or convenient to enter into a contest, on account of the complete satisfaction felt with their own products.

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North America was represented almost as poorly in the twelfth group as England. Here, also, lithographing proper was only represented by one firm and one book. The great firm of the world, D. Appleton &

Co., of New York, thought it had done enough for the honor of America and itself by keeping one volume of an illustrated work about North America locked up in a case. Well, the firm has proved, practically, that it can exist without an exhibition; but others can exist as well as they, and furnish articles as good as the above-mentioned volume. With pleasure we recall, not an extensive and finely gotten-up work, but a book that is interesting, and, at the same time, instructive for book-printers, O. A. Harpel's Typograph, (Cincinnati, Ohio.) This author originated the happy idea of collecting a number of specimens of job-printing made by him. Upon about 200 pages we find from 600 to 700 patterns of various kinds, giving an excellent proof of the variety and exactness of the work of American type-foundries, and of the capability of American type-setters and printers. The book is worthy to be purchased by every typographer.

A prominent exhibit was that of the American Bank-Note Company of New York, containing hundreds of specimens, such as postage-stamps, seals, bank-notes, &c., which were produced with great correctness and completeness. The steel plates for these samples are all furnished by the Bureau of Engraving and Printing of the Treasury Department, at Washington, and must be pronounced *perfect*, as regards technical production. All, large or small, are simple and free from overloading, which sometimes assists imitation instead of preventing it.

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The "Far West," North America, the best customer for chromos, was formerly forced to take imported articles, but now has some important establishments producing these articles. Among these is that of L. Prang & Co., of Boston, which is not surpassed by any in Europe, and is equaled by very few. Prang's works not only enjoy a great reputation in America, but go to Europe in considerable quantities. Among his landscapes, groups of fruit and flowers, as well as his genre pictures, are some worthy of being placed in a cabinet, but also ranking somewhat high in price. We mention, as examples, the pretty genre picture-pendents "The Farewell" and "Family Picture at Pompeii," after Joseph Coomans; the landscape "The Yosemite Valley;" the groups of fruit after C. P. Ream attaining a truth to nature which is astonishing. Excellent examples for object-lessons are also produced in this model institution. Duval & Hunter also command notice. They furnished some excellent pictures, but they cannot compete with Prang; they work a little too much for effect.

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255. A new graphical artist deserves to be mentioned, although it is not yet possible to form an opinion of his capacity. We mean *sand*. Mr. B. C. Tilghman, now in London, conceived the idea of blowing sand upon glass to make it dull, when observing the effect which the sand, raised by the wind, had upon window-glass. Since he found in the course of his trials that soft substances resisted the action of the sand-

blast, while the hardest steel plates were easily cut through, he was led to making templates of soft material in such a manner that the spaces alone were attacked by the sand, thus producing a picture well executed and transparent. Mr. Tilghman continued his experiments and made the most beautiful work in stone by covering the parts that were to remain with a layer of India rubber or other soft material.

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256. Conclusions of the Reporter of Group XII.—Once more we are on the eve of a universal exhibition; this time, however, in the New World. It is absolutely useless to discuss the question whether this rapid succession of universal exhibitions is really beneficial to the trades, and whether an international regulation of these exhibitions, with reference to the periodic meeting of savants and others, were not desirable and necessary in order to attain the real objects of a universal exhibition. They will be repeated, in spite of the assertion, made on every occasion, that it should be the last; and when they take place hardly any country can exclude itself without injuring its industries.

As regards the profession of letters, which gives a tangible expression to the products of mental aspirations and of life, it may be safely asserted that no country beside England can be more interested in the exhibition at Philadelphia than Germany. After England, no people has taken a greater part in the progress of civilization in America than the Germans. Those many millions of Germans that live in America, and aid honestly in extending the German language, literature and customs, who are still lovingly attached to their mother country, mourning with it and rejoicing with it—all these have the right to demand of Germany that she shall show the New World that she does not merely know how to conquer with arms, but that her industries have attained a position which makes them worthy of their high mission, associated as they are with German education, literature, science and art.

But let us confess candidly, that the capacity of the Germans for making felt the influence of their accomplishments does not keep pace with those accomplishments themselves. The *Cercle de la Libraire*, of Paris, has shown us how to attain success. If it is a dishonor to learn from a competitor, then universal exhibitions are of no use whatever. Therefore let us learn from them. At a universal exhibition, only that is credited which is demonstrated to the senses. If this is true in the Old World, how much more will it be true with a people which we especially call practical. Therefore a worthy and complete representation at Philadelphia is evidently in the interest of the German book-trade.

It seems almost as though Vienna had not been without influence in producing this impression. While this report was being printed, the members of the *Deutsche Buchdruckerverein*, numbering about 800 German book-printing firms as members, and among them the majority of the most important, has put upon its programme the question, whether

a collective exhibition of Germany, Austria, and Switzerland, at the Philadelphia exhibition, would not be desirable. Those peoples who are related to these, by race or by trade, may join if they desire. This is all that can be done by the book-printers and by the *Deutsche Buchdruckerverein* to inaugurate such a plan. It is not improbable that the directors of the *Börsenverein für Deutschen Buchhandel* will place this question on its programme for the regular meeting.

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GROUP XIII.

MACHINERY AND MEANS OF TRANSPORTATION.

REPORT BY PROFESSOR HERRMANN, PROFESSOR DR. HARTIG, ASSISTANT ENGINEER T. RITTERSHAUS, DIRECTOR A. WÖHLER.

SECTION II.—*a.* MACHINE TOOLS.

257. Referring to the number of teeth of their cutters,* those exhibited by the Brown & Sharpe Manufacturing Company, of Providence, R. I., show a marked improvement. They have a much smaller number of teeth, and therefore a greater intermediate spacing. The front face of the tooth is plane and almost radial, showing the exact form of the space to be cut out on the wheel. The back of the tooth is formed in such a manner that the form of the tooth is radially shown as it is carried along a spiral. The same form of tooth will, therefore, always remain, if we grind the face of the tooth by the plane surface of a thin grindstone. The cutter can, therefore, be used until the whole tooth is ground down to the very end. If we remember how much trouble and work accompanied the old method of annealing, cutting, and hardening the cutters, and how much the quality of the steel was deteriorated after this process had been repeated several times, we must acknowledge that this method of forming cutters is very rational.

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258. *Turning-lathes.*—The highest rank among the makers of turning-lathes exhibited was accorded to Sellers & Co., of Philadelphia, for the self-acting slide-lathe, which they exhibited, and to those of the *Maschinen-und Waggonfabrik der kungar Staatsbahn*, in Pesth, for its car-wheel turning-lathe; to the former on account of the excellent arrangement of all parts, to the latter on account of an unsurpassed beauty of form; to both on account of exact and excellent workmanship. The many improvements contained in Sellers' turning-lathe are the result of a careful investigation of all the forces acting in a lathe, of the laws of abrasion, and the required amount of comfort necessary for the workman in handling the machine. Even the less intelligent workman thus becomes capable of producing accurate work.

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Screw-cutting machines.—Among the screw-cutting machines proper, that of Sellers, for clamp-screws and nuts, deserves most attention; its form was the same as that of the tool exhibited in 1862 at London.

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259. The bolt and nut cutting machinery exhibited by the Brown & Sharpe Manufacturing Company, of Providence, is of striking sim-

*Of milling tools.

plicity. * * * * The reversal of the direction of rotation of the tool is produced by a pressure or a pull on the work

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260. *Tools for clamping and marking.*—Among the apparatus for clamping, used by metal-workers, the greatest interest was created by the vise of Thomas Hall, of Florence, Mass., in the American department of the machinery hall. It united all the convenience usually required of good screw-vises; parallel position of the jaws, quick opening to any required width, clamping of the work by a single motion, capability of revolving about a vertical axis, and the prevention of revolution by the same motion, and complete protection from the entrance of filings or dust into the revolving mechanism. * * * * The number of movable pieces of this apparatus is twice as great as that of a common screw-vise, and this circumstance will probably delay its universal adoption. But the handling of the apparatus, when used, is surprisingly simple.

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261. *Special machines for working metals.*—The automatic gear-cutting machine, exhibited by Sellers, stood in the American department of the Exhibition, as a highly important improvement in the department of machine-tools. Not only did the cutter work automatically in its rotary and translatory motion, being driven by the main spindle, but the periodic rotation of the work was accomplished automatically. This could be regulated for any number of teeth from 10 to 360; the machine being proportioned for working wheels up to 1,370 millimeters (54 inches) diameter, and 228 millimeters (9 inches) width of face.

262. The screw-machines, exhibited in different sizes, by Brown & Sharpe, deserve special mention. Several revolving, drilling, milling, and thread-cutting tools act here in any required order, being either placed in a disk (turret) revolving horizontally, or in common horizontal and vertical supports.

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263. One of the most original special machines in the American department was West's tire-setter, exhibited by the Mowry Axle and Machine Company, Greenville, Conn. It is employed for shrinking iron tires upon wagon-wheels, while cold; this is done by a strong steel band, which could be shortened to correspond to sizes of wheels by means of a strong screw. The iron tire is thus compressed in all directions, and finally fits firmly upon the wheel.

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II.—Wood-working machinery.

264. *Special machines for working wood.*—The firm of Baxter D. Whitney, Winchendon, Mass., exhibited a set of machines for manufacturing wooden pails. * * * * The execution of the pails thus produced is perfect, and their appearance is very elegant.

265. Great surprise and interest was awakened by the machine for making a new joint for boxes and furniture, invented by Knapp, and made and exhibited in the American department of the machinery hall by the Knapp Dovetailing Machine Company, of Northampton, Mass.

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Section II.—*b.* Textile machinery.

266. *Machines for spinning wool.*—A third machine of the above-named kind* was that exhibited by an American, Mr. Avery. The apparatus for drawing the wool, which is applied in this case, is entirely new and original.

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A very pretty and effective apparatus, which was remarkable for its simplicity, was used for making the ring-bench rise and fall, so as to allow of winding the product upon spools resembling mule-cops. This was effected by automatically forming several spirals on an attachment to the machine, upon conical surfaces vibrating up and down.

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267. *Sewing-machines.*—Probably no other kind of machinery was represented by so great a number of exhibitors at the Vienna Universal Exhibition as the sewing-machine. It may be thus seen how widely distributed and general is the use of this machine, in the household as well as in the trades, and how important a position it has attained in the course of but two decades. The machines exhibited did not show any new principles of construction, but the systems produced first in America contained the essential parts of all these machines. Various improvements have, however, been made in details, thus making it so practically important and its application so general.

The exhibit of sewing-machines illustrates the interesting negative result, that certain systems, especially those using a single thread, are no longer employed, except, perhaps, in chain-stitch machines.

268. For real sewing, almost the only single-thread machine which has been retained in use is that of Wilcox & Gibbs, which is very efficient for certain kinds of work, on account of its simple construction and great speed. Driven by steam-power, it worked at the rate of 4,000 or 5,000 stitches per minute. For sewing the soles upon boots, the simple chain-stitch is still employed, as, for instance, in the machine exhibited by Weber & Miller.

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269. Almost the same remarks will apply to the double-thread machines with chain-stitch, made by Grover & Baker. This system was only represented by a few examples. The disadvantages of this method of sewing, are the lack of durability and the great amount of thread used, which limit the system almost exclusively to ornamental sewing.

270. Almost all machines made for plain sewing make the double lock-stitch, a fact which might have been predicted as a consequence of

*With fixed spindles.

the great superiority of this stitch. Here, however, we find two competing systems, that of Howe and that of Wheeler & Wilson; and the question has not yet been definitely decided, which is the more advantageous. This question is, in reality, only important for family sewing-machines. It has only been recognized that the Wheeler & Wilson machine is a most suitable one for sewing under-wear and linen, on account of the great speed at which it may be driven, but, at the same time, the Howe system has been recognized as possessing an advantage for heavy work in its straight needle.

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It is, however, noticeable that the Wheeler & Wilson Sewing-Machine Company, of New York, exhibited a new machine, No. 6, in which the rotating hook was still retained, but the bent needle was replaced by a straight one, and the motion of the needle was so changed as to resemble more nearly that of the other system. These changes were made, so as to make the Wheeler & Wilson machine capable of being employed for heavier work.

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271. VARIOUS MACHINES.—In the American department a cloth-cutting machine was exhibited by Albin Warth, of New York, being made for large clothing establishments. * * * * But a single pattern is used in this apparatus, and this is cut out as many times as there are layers of cloth in a single cut.

272. H. C. Covert, of New York, exhibited a brush-making machine, invented by Woodbury. This machine excited considerable interest, both on account of its ingenious construction and its excellent work. * * * * The work is done very rapidly, seventy-five holes being filled with bristles in a minute, thus producing a common scrubbing-brush in the course of one minute. As the holes do not penetrate through to the back of the brush, but are only drilled a little way into the wood, the surface of the brush need not be covered with veneer. The most elegant brushes can thus be bored without injuring the backs. The strength of the fastening is so great that the bristles can only be drawn out by destroying the wood.

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GROUP XV.

MUSICAL INSTRUMENTS.

SECTION I.—INSTRUMENTS WITH KEYS.—PIANO-FORTES.

REPORT BY DR. OSCAR PAUL.

273. Although in London, in 1862, Broadwood still retained supremacy, and Erard's double escapement, simplified by Herz of Paris, and by Pleyel's "action," patterned after Broadwood, attracted great attention, nevertheless there existed already sufficient reason for the consideration of other manufactures which did not originate in London or Paris.

The heaviest blows against the old systems alluded to which were considered unimpeachable by both the English and French, was dealt at the World's Exposition in 1867, by the firm of Steinway & Sons, which opened new paths for the entire piano-forte industry, principally causing the German preponderance in the piano-forte manufacture.

The German inventive spirit and Steinway's practical knowledge have operated so potently that it may be affirmed, without fear of contradiction, that Steinway's productions, having been victorious in Paris in 1867, after many severe conflicts, have since been universally copied by piano-makers, and thus received in Vienna the very highest recognition.*

Inasmuch as in the International Exhibition at Vienna, 1873, the Steinway system appeared, represented by the manufacturers of every land, partly copied unchanged, partly with slight alterations, and so to say controlling the entire art of piano-making; and inasmuch as science admitted these systems to the foremost rank, duty compels us to consider them more fully, and to state the reasons which influenced the inaugurators in the introduction of their inventions. The overstrung system of Steinway was opposed in the most vehement manner, until the conviction found ground that further progress could be achieved with this system only. Its value and merit were sought to be belittled by the statement that the inventions did not originate with Steinway, but with Lichtenthal in St. Petersburg—a mistake founded upon ignorance of the facts. In fact, the matter stands thus: The first grand pianos made in 1856, by the firm of Steinway & Sons, were straight scale instruments with full iron frame, with an harmonic treble bar of

* This fact was specially mentioned by the jury of the Vienna Exposition, though the firm of Steinway & Sons had not exhibited, and it was even resolved in a session of the group jury to embody in the report of the section the following resolution: "As regards the American division, it is much to be regretted that the celebrated and 'new systems inaugurating' (bahnbrechende) firm of Steinway & Sons of New York, to whom the entire art of piano-making is so greatly indebted, have not exhibited."

brass or iron and with agraffes, serewed into wood, in the middle register and bass. These grands not only found ready sale, but also enjoyed general appreciation, so that they were frequently used in eoncerts, and large numbers were sold.

The firm then obtained several patents for new improvements for grand pianos, the most important one in December, 1859.

The complete east-iron frame, with the projections for the agraffes lapping over and abutting against the wrest plank, contained an entirely new disposition of the strings and braces, which was adopted for the following reasons: It had been observed that in square pianos the *oblique* strings, when rotating and vibrating under the blows of the hammer, developed a pliable and sympathetic quality in spite of comparatively heavy strings. The same result was observed in oblique upright pianos when they were eompared to the same style of instruments with the straight scale. In grand pianos, this pliability eould be attained but approximatively, and only at eost of loss of enduring quality in the tone by a disproportionate weakening of the sounding-board—in its position of bars—to its size. If in straight-seale grand pianos the same heavy strings were used as were admissable in the square pianos of the new eonstruetion, as already deseribed, the inerease of tone thereby gained was at eost of mellowness. The tone possessed a eertain harshness, and, when foreed, it developed that disagreeable metallic "whistling" of the heavier steel strings. To diminish all these evils, if not entirely to overeome them, the spreading of the strings upon the bridges of the sounding-board, or the fan-shaped disposition of strings, was adopted as offering many advantages. In the treble of the grand piano, the direetion of the strings parallel with the blow of the hammer was retained, beeause, in this part of the instrument, as in the square, experienee has proven that the strongest tone is produeed by this disposition of the strings. From the middle of the treble, the strings were spread on the line of the sounding-board bridge, from right to left, fan-shaped, as far as space would permit.

274. The upright piano was very unpopular in the United States; those which were imported did not stand the climate, and Ameriean manufacturers did not know how to give to this small, but for the parlor so pleasing, form, the necessary durability. After many experiments and practical improvements, Steinway & Sons construeted an upright piano whieh was patented in 1866, and whieh was reeognized by the musical authorities as eomplying with all demands. Former experiments in attempting to strengthen the frame by iron were made at the saerifice of volume and power of tone, and the abnormal changes of temperature and variation between dampness and dry, piercing air operated in a surprisingly destructive manner upon their short wooden frames, (*Holz Körper.*) Not until the firm of Steinway & Sons had made observations as to the manner of the produetion of tone in the sounding-boards were they enabled to use iron for the frame of this instrument, while leav-

ing the sounding-board entirely isolated and independent of the iron frame.

The sounding-board is made, as is well known, of spruce, which, with its soft and hard grain, is recognized and is used as the best material for the construction of sounding-boards. No scientific and correct explanation has as yet been made, indicating why this material has proven practically the best for sounding-boards. It is well known that the direction of the grain in the sounding-board as well the position of the bars, either above or more generally below the board, and their forms, have been manifold, and have been used in every possible manner and shape. Every imaginable direction and position has found its advocate, but without important differences in the ultimate result. It is, moreover, a well-known fact that beauty and volume of tone in an instrument depend most materially upon the sounding-board, and mainly from its quality to react against the molecular vibration of its most delicate inner fibers. This latter process, as already stated, puts the air-column surrounding the sounding-board into that vibration which to the ear is perceptible as "tone." The pressure of these several particles of the sounding-board against each other more or less determine not only the power of tone but its susceptibility, and the singing quality also depends greatly upon it. The natural strain and tension of the sounding-board is soon lost, in spite of selection of the dryest wood, not only by changes from dampness to dryness, but in consequence of the use of the piano. Air constantly damp gradually dissolves the oils and swells the woody fibers against and above each other, and by this action, upon the setting in of dry weather, the previously existing pressure and support against each other are diminished. A similar consequence results in course of time from the continued tremor of the sounding-board by use of the piano, whence it is that a new piano sounds fresher and is more powerful than one that has been used, even if the latter has a perfectly new action. It is, moreover, to be considered that it is absolutely impossible to determine the degree of this pressure with forces over which we have no regulating control. With the action of dampness and dryness when manufacturing the sounding-board, it was principally the force of the strings and the thereby originating compression, more or less, of the case, (*Körper*,) with the rims of which the sounding-board is firmly united, which gave some pressure to the latter. If, for instance, pianos had such strong iron frames that there remained no elasticity for that compression which is so essential to sounding-boards, a weak, dull tone was in every case the result. These patented improvements, June 5, 1866, were first applied by Steinway & Sons in an upright piano.

This instrument has a solid iron frame, the rear braces and front plate united, so arranged that one side is open; into this open space the sounding-board can be slipped. In the rims of this double iron frame, there are a number of peculiarly constructed screws, with concave

heads, so arranged that they in every case fit against the end of the braces of the sounding-board, which braces cross the fibers of the spruce board. The solidity of the iron rims permits the application of an extraordinary pressure, by means of the screws against the rims of the sounding-board, and the position of the screws is such that the applied pressure gives to the sounding-board a rising tension against the vibration of the strings. The effect is a considerable compression of the wood fibers of the sounding-board, which is to a certain degree fixed by practical experience. This compression operates from the outer rims to the smallest particles in the middle of the board, and enables the latter to reproduce powerfully the effects of the strings, even the very slightest vibrations of the strings, whereby the tone attains a remarkable length and singing power, with clearness and a noble quality, because the sounding-board as a whole can make no transverse vibrations, (*schwingungen.*) If it is considered that the whole thickness of this iron frame is but 4 inches, and that its erect position within the outer wooden case permits an inclination toward the front, it offers a considerable advantage for touch, as the fall of the hammer becomes natural, (it falls back by its own weight,) while the piano itself stands more securely and cannot tip over.

The first upright piano of this kind was finished in February, 1866, and was exposed by Steinway & Sons to the most unfavorable influences, in order to test its durability, but both touch and capacity of standing in tune proved better than ever known before. The same apparatus was, with the very best results, applied to grand pianos, while formerly a looseness of the board very soon appeared, owing to its bulk and the natural porosity of the wood. It has evidently proven a means of improving the quality of tone of an instrument. This regulating apparatus introduced by Steinway & Sons, under the name of the "resonator," permits the production of a good and a more perfect instrument than hitherto, where the result as to tone depended upon mere accidents, which, in constructing a sounding-board, influenced its internal tension.

275. Concerning specially the pre-eminence of the Steinway pianos as regards volume of tone, it is due to the material used and to successful construction, but, above all, to the industrious observation of Theodore Steinway, whose acquaintance with the theories of Helmholtz induced him to make the minutest researches and acoustical experiments. The law of the consonant overtones is adhered to, and surely no piano is to be found which, in consequence of a too prominent consonance of disharmonic overtones, develops the shrill so-called "klimpern." That quality of tone, which is recognized as beautiful and as according with the laws of acoustics, has been reached by Steinway & Sons, even in the upright pianos, by the screws and the iron frame preventing the sounding-board (as a whole) from making transverse vibrations, yet developing a capability of receiving the effects of the blows of the hammer, creating vibrations of the strings,

with the necessary resistance, and preventing the sounding of discordant tones. The heavy bass strings were evenly distributed from right to left, above the other strings, upon a sounding-board bridge in rear o^c, and higher than, the first bridge. The advantages of this system were various. The lines of the sounding-board bridge were considerably prolonged, and greater surfaces of the sounding-board, which were hitherto inactive, were brought into action. Between the strings there was far more room than formerly, whereby the effect of the sound of the strings could be developed more voluminously and freely from the board. The bridges came more nearly into the center of the board, away from the iron covered rims, thus better transmitting the vibration of the strings to the sounding-board, and contributing considerably to the production of a greater volume of tone. By retaining the same size of the piano, a greater length was gained for the strings. The system of bracing (*spreizen*) became more effective; the second oblique (or transverse) brace running parallel with the highest bass (*basschore*) (bridge?) formed with the third an acute angle just at that point where the arch (*bogen*) which sustains the bass strings finds a natural point of support. The position of the middle and lower strings meeting the direction of the blow of hammer, produced those vibrations which gave to even the heavier strings a softness never before attained, together with a greater volume of tone.

The invention of laying the strings over and above each other is certainly a very old one. Even before the invention of the hammer-piano there was added to the bass strings of the old clavichord a string sounding the higher octave. This string was fastened upon a bridge which is situated below the lower strings upon the sounding-board. Various experiments to utilize the crossing of the strings failed utterly, so that even authors of repute believed that strings lying above each other throw their respective vibrations into confusion. This, however, is not the case, as is sufficiently proven by Helmholtz's analysis of the system of sound-waves. This is done no more when lying above each other than by strings lying side by side.

The unfavorable results which former experiments of this sort furnished, were a consequence of a mistaken practical application, viz, by bringing the bridges, in crossing the strings, away from the middle of the sounding-board, and more toward its rim. In consequence of this same faulty construction, the space between the strings upon the bridges was necessarily more and more contracted instead of being enlarged. Science and practice have demonstrated that the transverse vibration of the string, as such, does not produce musical sound in the air; only the effect, communicated by the vibrating string to an object susceptible of resonance, causes again in this object those molecular vibrating waves which communicate themselves to the surrounding air, and, in that manner, are perceptible to the ear as sound-tone. The firmer the string is fastened at one end—and this was here attainable to the high-

est possible degree by the solid iron acute angle-piece—the more must the whole effect fall upon the elastic part, the sounding-boards.

At the Paris Exposition of 1867, Steinway had to contend against violent attacks, of long duration and rather expensive. Every piano in the Vienna Exhibition of 1873 which had remained untouched and uninfluenced by Steinway's newer construction and improvements, appeared antiquated and of reduced value. The most prominent firms to whom honorary diplomas were awarded, proved, by their constructions, that Steinway's system was their model, and that they, as regards the action of the piano, were but imitators of Erard's, or but partly relied on their own resources.

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276. As regards the American Department, the jury of Group XV regretted that the celebrated inaugurators of new systems in piano-building, Messrs. Steinway & Sons in New York, to whom the entire art of piano-making is so much indebted, were not represented, so much the more so as the firm have again excited the attention of scientific research by a new system.

A grand of Steinway's make, owned by Count Henkel von Donnersmark in Vienna, is constructed with such arrangement and distribution of strings that that section of each string lying in front of the agraffe, and which in other grands is mute, vibrates whenever the hammer has caused the string to sound its fundamenal note. That portion of string in front of the agraffe, according to the law of overtones, is of such a length that in it there appears the octave of the fundamental tone, thereby materially strengthening the first overtone, whereby the middle and treble of the grand acquire a marvelous fullness. To my personal knowledge Helmholtz expressed himself in favor of this new acquisition to science in the most emphatic manner. This extremely ingenious construction, based upon scientific discernment, is due to Mr. Theodore Steinway, who devotes himself specially to the utilization practically of the analysis of Helmholtz.

As early as the seventeenth century an additional string was added in grand pianos, to the principal set, which sounded the higher octave, and for the purpose of strengthening the octave. The continual difference in the pitch between the principal set and the additional strings destroyed the illusion when playing, so that the old octavlin practically never was fully recognized.

Through the Steinway mechanism the principle of the development of partial tones is magnificently developed, and surely we will not need to wait long for the general adoption of this system more than for that of the overstrung system. All honor is due to the maestro, Steinway, of German blood, who knows how to combine successfully scientific discoveries with their practical application, and who is the pioneer in inaugurating new systems, and who leads all his associates in art.

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GROUP XVIII.

MECHANICAL AND CIVIL ENGINEERING.

SECTION III.—ROADS, BRIDGES, AND RAILROADS.—TUNNELING.

REPORT BY GEH. OBERBAURATH SCHWEDLER, OBERBAURATH H. STERNBERG, GEH. BAURATH GIERSBERG, BAUMEISTER HOUSSELLE.

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277. The United States War Department (J. Newton) sent a model of another important enterprise, which cannot strictly be classed as a tunnel, but which is mentioned here on account of the similarity in the method of execution. It exhibited the method of blasting, to increase the depth of water at Hallett's Point, N. Y. A shaft was sunk at that point, within a coffer-dam, and galleries were run in all directions radially from this, and at the depth to be obtained by the blasting. These galleries were filled with powder, and were then all to be exploded at once. This method cannot be regarded as an advance in general practice, and probably it was favored by local conditions.

EXTRACTS

FROM THE

OFFICIAL REPORTS TO THE AUSTRIAN GOVERNMENT

RELATING TO THE

EXHIBITS FROM THE UNITED STATES

AT THE

INTERNATIONAL EXHIBITION, VIENNA, 1873.

TRANSLATED BY

A. SORGÉ, M. E.,

UNDER THE SUPERVISION OF THE EDITOR.

OFFICIAL REPORT OF THE EXHIBITION.

GROUP I.

MINING AND SMELTING.

SECTION 1.—MINING PRODUCTS, WITH THE EXCEPTION OF FOSSIL FUELS.

REPORT BY DR. FRANZ V. VIVENOT.

278. UNITED STATES OF NORTH AMERICA.—Mining products and collections of minerals were exhibited by several persons. Among these was the interesting collection of Professor Küstel, the value of which was greatly increased by the chemical analyses which were attached to the various minerals, and we will, therefore, consider it more closely.

It contained minerals from California, Nevada, Arizona, Idaho, and Utah. The rich ores of Utah Territory were also particularly well represented in large cabinet specimens by Professor Küstel.

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In the exhibition of Utah Territory was a cube of the granite of which the Mormon temple is built, fire-clay, rock-salt, and silver-ores; among the latter was a very rich piece of chloride of silver from the Eureka mine; galena, one of the pieces containing linarite, which resembles very much the Rézbanya of Hungary; lastly, copper-ores from the Mammoth mine were exhibited.

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The model of a Comstock shaft was also very interesting.

SECTIONS 2 AND 3.—METALLURGICAL PROCESSES.

REPORT BY FRANZ KUPELWEISER.

279. In spite of the enormous wealth of North America in ores and coals, in spite of the great development of its railroad industry since the beginning of this century, it was represented in a very inferior manner at the Exhibition. Frequently there was a lack of information about the exhibits, or there were no representatives that could give information about them, and thus the little which was exhibited became even more valueless.

We can judge of the great progress made by the United States of North America within the last few years in the production of iron, from the following table, taken from the Coal Statistical Register for 1872, published at Pottsville:

The production of pig-iron was—

	German official cwt.
In the year 1810	600,000
1830	3,300,000
1840	6,900,000
1850	12,000,000
1860	18,275,480
1864	24,080,000
1866	27,018,660
1867	29,232,520
1868	32,060,000
1869	38,332,820
1870	37,000,000
1871	38,000,000
1872	46,000,000

According to this table, the production has become seventy times as large as it was originally, within sixty years, and has been doubled within the last ten years. It is scarcely credible that America still imports large quantities of iron from England, and even from Sweden, in spite of this immense development of its iron industry. The ores of North America must partly be transported great distances to be worked; the hematites from Marquette, at Lake Superior, are transported by water or by rail to the place where they are worked at New York, and Pittsburgh, Pa., a distance of about five hundred German miles. On account of the great expense for transportation, only those hematites and magnetic iron-ores, containing more than 60 per cent. of iron, are used. Since ores are found in great abundance, it has already been proposed to export part of them to Europe. The production of pig-iron is concentrated mainly about Pittsburgh, Pa., where there are many large coke-furnaces, producing from thirty to forty tons (600 to 800 cwt.) iron per twenty-four hours. Anthracite blast-furnaces at Lake Champlain also furnish pig-iron. Nevertheless, there are a number of Catalan forges at Trenton, N. J., producing rod-iron directly from the ore.

280. Great progress has been made within the last few years in the application of metallurgical processes. The rise in the production of steel, for instance, can be seen from the following notes, made by Mr. M. MacAllister, secretary of the Society of American Furnace-Owners.

The production of steel amounted to—

	German official cwt.
In the year 1865	305,240
1866	379,460
1867	380,000
1868	600,000
1869	700,000
1870	1,500,000
1871	2,000,000

This production of steel, which is mainly made by the Bessemer process, will probably rise in the immediate future, since a great number of Bessemer plants are being built.

The Bessemer steel is employed mainly for rails (1,200,000 cwt. in 1871) and other railroad materials. Mr. Danks has also made experiments for the improvement of, and saving of labor in, the puddling process.

The following exhibitors deserve special mention:

281. Park Brothers & Co., of Pittsburgh, exhibited crucible cast-steel, and rods and plates (boiler-plate) produced therefrom, and of excellent quality; various plates furnished with edges, and boiler-plates bent double while cold, were added, in order to show the quality of the material.

The Atlas Works, of Pittsburgh, Pa., exhibited pig-iron, chilled and very strong iron, which broke with a load of 24,270 pounds per square inch, according to testimonials furnished with it. Among the chilled castings exhibited, special mention should be made of hammer-heads, &c.

282. The Clifton Mining Company exhibited not only pig-iron, but also bar-iron, made directly from the ore in Catalan forges, and exhibited excellent quality. Similarly, Alabama exhibited gray cold-blast pig-iron and Connebleville coal, coke dark-gray pig-iron, with the slag formed in the process.

Special interest would have attached to an exhibit which arrived very late, if there had been an explanatory pamphlet, or if the exhibitor had only deigned to answer a written inquiry.

General I. T. Wilder, of Tennessee, exhibited ores, red-iron ore, coals of excellent quality, a bloom of about 10 cwt., which had evidently been produced in a revolving furnace, and a cylinder $3\frac{1}{2}$ feet high and about 12 inches in diameter, which had been stamped or forged out of such a bloom, and also finished rails. But, as already stated, no information could be obtained about the process of manufacture.

283. We must also mention the model of a revolving puddling-furnace, after Danks's, exhibited by Henry Richman, and the actual size revolving puddling-furnace of William Sellers & Company, of Philadelphia, which merely differs from Danks's furnace by the following modification:

It is not fired directly, but by means of gas, in a manner resembling Siemens's system, this being, however, omitted at the furnace exhibited. The working-space consists of a revolving, pear-shaped vessel, which is driven by steam, and can be removed from the fire-space in a circular path. The performance of the few mechanical operations necessary in the furnace takes place through a door, which is attached at the fire-side. The rotating furnace consists of iron, and is lined with a mixture of 100 parts by volume of fine ore, 20 parts of hydraulic cement, and 18 parts of soluble glass to a depth of 2 inches; it is then heated to a red heat, and fluid slag is poured over it, to which ore is continually added

until a thickness of 4 inches of ore has been obtained. If a cavity is formed in this coat, it is broken out down to the first lining, filled with ore and fluid slag, and is then cooled somewhat. The charge consists of one ton of cast iron, which is introduced in the fluid state, (usually from a cupola.) The furnace is revolved at the rate of eight revolutions per minute, and the iron is said to be reduced in thirty minutes. The rather large quantity of slag is now let off, and the furnace makes about ten revolutions within five minutes, in order to collect the iron in a bloom, and this is then taken out for further mechanical operations. Since the lining is attacked very much during this process, 350 to 400 pounds of ore are required in order to effect the repairs. One man is employed for each furnace, while five workmen are still needed for every five furnaces, in order to do the charging and discharging.

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284. *Nickel and cobalt.*—Mr. Joseph Wharton, of Philadelphia, produced a very interesting exhibition of these two metals. They were not only exhibited in the metallic form, in cubes, but also in cast plates. According to the statement of the exhibitor, they are chemically pure, and free from arsenic; and he employs a furnace which has been constructed for the special purpose of reducing cobalt. These plates are used as electrodes. Besides these metals, Mr. Wharton exhibited salts of nickel and cobalt, native ores, and blue vitriol and copperas.

We must also mention the Keith Nickel-Plating Company, of New York, which exhibited metals with nickel-plating, which seemed to be very uniform, and are said to wear very well.

GROUP II.

SECTION 1.—FERTILIZERS.

REPORT BY ANT. ADAM SCHMIED.

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285. Among the mineral collections of Group I, we saw numerous raw materials in the form of mineral phosphates, which could be advantageously employed for artificial manures. Geo. W. Beckwith, of Burlington, exhibited specimens of soluble phosphates from the Green Mountains, United States, which are said to contain 18.18 per cent. phosphoric acid.

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Stern's Fertilizer and Chemical Manufacturing Company of New Orleans, La., exhibited several kinds of animal charcoal, besides bone-dust, and several superphosphates extracted from raw bones.

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GROUP III.

APPARATUS OF CHEMICAL MANUFACTURE ON A LARGE SCALE.

Report by Johann Stingl.

APPARATUS FOR MANUFACTURING ILLUMINATING-GAS.

286. The most interesting, and, at the same time, the most recently-invented gas-machine was the so-called Excelsior, invented by Th. B. Fegarty, of Warren, Mass., in the United States of North America. This apparatus produces a carbonized air for illuminating-purposes. Air and gasolin, a volatile product of petroleum, are the raw materials for preparing this kind of illuminating-gas. This end is attained by a very ingenious contrivance, which differs widely from those adopted by others.

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Section 7.—Starch, etc.

CHEMICAL INDUSTRY.

Report by Dr. Wilhelm Fr. Gintl.

287. North America.—The manufacture of starch in that country has the peculiarity that it is almost exclusively limited to corn-starch. Owing to the peculiarities of soil and climate of the country, corn is raised with great facility. Therefore, this raw material is preferred to the cereals proper, and for the last thirty years it has nearly displaced wheat and potatoes for the manufacture of starch. Some weight may also be attributed to the circumstance that the manufacture of starch is not an auxiliary business to husbandry, but a wholesale manufacture.

Independence of the season, large yield and small waste, and, above all, profit, are essential conditions in the choice of the raw material. Four firms in all exhibited their products.

A. Erkenbrecher's St. Bernhard Starch Works, Cincinnati, Ohio, deserves to be mentioned in the first place. He exhibited two kinds of corn-starch, *crystal gloss starch* and *refined corn-starch*. Both products were of excellent quality, and appeared pure white, without being brilliant. Mr. Erkenbrecher generally uses the white variety of corn for the manufacture of starch, and prepares the superior kinds of starch which are destined for food by washing the ground grain in a manner which is similar to Martin's in principle. For obtaining the starch from the hard parts of the grain, a process of maceration by alkaline fluids is employed, yielding, however, only inferior kinds of starch. The offal and remnants are used partly for fodder, partly for manure; the husks and cobs serving as fuel. The St. Bernhard Starch Works are

worked by machinery, the daily product being about 400 to 500 hundredweight of starch. The extent of the business of this firm is evidenced by the fact that it has agencies in most of the larger states of Europe and America, paying a special attention to the export.

Other important manufacturers of starch in North America who exhibited their products are George Fox, also of Cincinnati; Stein, Hirsch & Co., of Chicago; and Chr. Morningstar, of New York. All samples exhibited were of excellent quality, especially the samples of *silken gloss starch*, and the *refined corn-starch* proved in no way inferior to the products of the St. Bernhard Starch Works. The corn-starch for food exhibited by Chr. Morningstar must be adjudged an excellent product.

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288. RESINS.—North America, whose chemical exhibits were on the whole of very limited extent, was represented in this division by only one exhibitor. C. L. Hauthaway & Sons, of Boston, exhibited leather-varnish for blacking shoes, which is certainly excellent for that purpose. Judging from a superficial examination, this fluid, in different colors, seemed to be an ammoniacal solution of shellac or perhaps xanthorrhea-resin, owing its colors to an admixture of lamp-black or bronze-powder. Although the application of solutions of shellac in ammonia for producing varnishes is nothing new, for C. Pusher (Fürther Gewerbezeitung, 1869, p. 18) had recommended it for water-proof paints, varnishes of this kind were not in common use for varnishing leather and shoes, perhaps for the reason that a constant use of ammonia cannot well but have a deleterious effect upon the leather. This possibility has to be taken into account before replacing the common shoe-blacking by this product, which certainly recommends itself by the facility of application and its splendid effect.

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GROUP IV.

Section 2.—Sugar-apparatus, etc.

Report by Dr. Josef Hanamann.

289. United States of North America and Brazil.—The manufacture of sugar is beginning to have a successful development in the United States of North America. This must naturally be the case in a country the inhabitants of which are led on by the spirit of progress.

The extraction of sugar from the colonial molasses, which is seldom exhausted perfectly, forms a specialty in the production of white sugar, in addition to the refining from crude sugar. In San Francisco, the number of refineries is steadily increasing. The position of the city specially favors the working of the common sugar from Honolulu and Manilla. Its market is not merely in California and Oregon, but also in Peru, Mexico, and the countries of the Pacific Ocean.

The consumption of sugar in North America amounted to over 460,000 tons in 1867 and 600,000 tons in 1870, of which 500,000 tons were used in the form of cane-sugar, especially in the States at the Atlantic coast, 32,000 tons of sugar from sorghum, corn, &c., and 23,000 tons of maple-sugar. Next to the English, the North American consumes most sugar of all the nations of the world, principally in the form of sirup, and the best sources give the amount of sugar consumed at 36 pounds per person. Besides the dark sirup, the refineries bring a white sirup into the market, a thickly fluid, uncrystallizable product, which is liked very much by Americans.

The extraordinary importation of sugar into the United States, which was valued at $70,000,000 in 1870, gives a vivid idea of the importance of the manufacture of sugar for these States. The sugar manufactured at home does not amount to one-eighth of the import, while Europe already obtains one-half of its sugar from beets. It is certain that the American States, which are so rich in means, will soon follow the example of Europe.

Most of the sugar exhibited came from New Orleans. H. Lawrence sent beautiful, white, crystallized sugar, and Penn exhibited snow-white, beautiful sugar of sharp grain, produced *in vacuo*, but having a somewhat sour taste. Johnson Bradish, of New York, had also exhibited some beautiful white sugar, well crystallized. Good crude sugar of light-yellow color, well-defined grain, but only made over an open fire, was brought by Consul Bader, of New Orleans, besides some excellent natural and reddish-brown sirup; while John Baar exhibited some refined sirup from the refinery, which had even a better taste. This crude sugar, however, was yellowish, mealy, and damp. The crude sugars of Arthur Dennis, of New Orleans, were much better; although

they were only evaporated over an open fire, they had a yellow color and well-defined grain. Patrick Kennedy brought gray, but strong, sugars to the Exhibition. They were cleaned by sulphurous acid and lime, and were evaporated over an open fire. Henriette Davidson, of Louisiana, also had similar sugar produced over an open fire without animal charcoal, then dried by centrifugal machines; they were somewhat gray, but sharp and crystallized sugars. A. Thompson & Co., of New Orleans, exhibited some granulated, refined, and palatable product, but his cubical sugar was less excellent.

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Section 3.—Fermented liquors.

Report by Dr. Eduard Schmidt.

290. America sent samples of spirits of maize, rye-whisky mixed with gin, and also whisky. The latter, a national drink, is made from barley and maize, in North America, having a peculiar empyreumatic odor and taste. The immense scale of manufacture of these articles in America is shown by the exhibitor, Gaff & Co., of Aurora, Ind. This firm alone produced 111,672,000 gallons since 1843, that is, in thirty years, paying a total amount of duty of $111,500,000.

Stomach-bitters, among them the aromatic cocktail-bitters, are in great favor there. They are employed as admixtures for all kinds of sparkling and not sparkling wines, with orange-juice and small pieces of broken ice.

Among the eleven exhibitors we can only mention as especially meritorious the firm of J. Gibson, Son & Co., of Philadelphia, for their rye-whisky, for which they received the medal of merit, and Charles Lediard, of New York, for their cocktail-bitters.

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Section 5.—Preserves, extracts, and meat.

Report by Carl Warhanek.

exhibition of preserves.

291. United States of North America.—North America apparently attempts to introduce into manufacture all the preserves of the European continent; for it exhibited, in this line, a whole collection, which were adjudged, by the jury, good articles.

America, like England, is fond of piquant and spicy food, these forming a part of this exhibit. Among them there are fish, vegetables, meat-extracts, stimulating-sauces, pickles, &c. As a novelty, among the preserves we found corn in the ear, and cranberries done up in their natural juice, with sugar, and in the form of marmelade. The air-tight covering of the preserving-jars was also new.

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GROUP V.

Section 2.—Cotton and cotton goods.

Report by Dr. Alexander Peez.

292. In the higher and fuller growth and the greater contents of the capsules of the cotton-stalks brought to the Exhibition by North America, as well as in the long-fibered, white, and silky flakes contained in the immense bales, we easily recognize the extraordinary advantages of the natural conditions which favor the growth of cotton in the Southern States of North America. The appropriate packing and the good cleaning of the article also reflect the advantage which a cultivation by educated people of the European race possesses over that by the natives of tropical countries. It is the picture of a flourishing business, of a production which is developing with great certainty, which speaks to us through the mighty exhibit of cotton by the United States, in spite of the almost careless arrangement.

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COTTON SPINNING AND WEAVING.

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293. It is a great pity that the United States sent scarcely anything to this branch of the Exhibition. James Y. Smith, of Providence, R. I., and the Langdon Manufacturing Company, sent a few very good specimens; but these gave no idea of the great cotton industry of the United States, which seems to be making greater progress within the last few years than its competitors in old Europe, on account of the near supply of raw material. The number of spindles is estimated at 8,350,000, with 160,000 looms. The number of factories was 956, and the wages paid in 1870 amounted to $40,000,000. It is a fact worthy of attention that small amounts of cotton fabrics, valued together at $2,300,000, are exported to Canada, Brazil, Mexico, Hayti, and China.

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Section 7.—Linen.

Report by Josef Migotti.

294. The classification of linen is generally made into four principal kinds, viz, common wearing-apparel, bed-linen, table-linen, and the more luxurious kinds of wearing-apparel, which again may be subdivided. We must, however, follow the geographical classification of our Exhibition, and commence with America, the land of inventions.

The firm of F. Sachse & Son, of Philadelphia, exhibited a remarkable kind of gentlemen's shirts, open behind, an innovation which gives the

advantage that they are not spoiled too soon by buttoning them at the exposed front. The whole collection showed a splendid finish, the like of which has not yet been attained in Europe.

S. N. Moody, of New Orleans, was distinguished by the precision of work on his productions, and especially by his particularly beautiful fancy bosoms. A sample shirt at the price of 400 florins ($160) was much admired, but whether this is a practical success is doubtful.

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GROUP VI.

Section 1.—Leather.

Report by L. Goldschmidt.

295. From America, the United States were represented by several manufacturers, who mostly exhibited sole-leather tanned in the American manner, with oak-bark. Among these, the leather exhibited by Thomas Schott, of New Orleans, was tanned especially well. Hemlock, the export of which to Europe increases every year, and of which very much was especially sold in North Germany in 1872, was also represented.

To enable the reader to judge of the important part taken by hemlock in the last year, we give the following statistics:

At the end of 1871, there were 300,000 sides in stock at Liverpool; an additional 600,000 were imported in 1872, and, nevertheless, the storehouses were cleared completely at the end of 1872; that is, 900,000 sides had been sold during that year.

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Section 4.—India-rubber goods.

Report by Isidor Schuck.

296. North America was represented in this department by one exhibitor, the Boston Rubber Shoe Company.

Only a few pairs of rubber shoes and a quantity of telegraph-wire covered with vulcanized rubber were exhibited, giving, however, no idea of the importance of this industry in America, where it is well developed. The manufacture of suspenders was better represented by the American Suspender Company of New York. Their wares, with well-worked rubber bands and elegant outfit, indicated marked progress.

Here we find division of labor in practical operation. This factory only makes the rubber bands for the suspenders, and has the leather parts made at another establishment. These parts are assembled to make up the finished suspenders.

GROUP VII.

Section 2.—Steel and iron ware.

Report by F. W. Haardt.

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297. Foreign countries exhibited to a very limited extent, as I have already mentioned. We looked in vain to England, France, and Germany for those large firms which lead the world's trade.

America exhibited in the Westfield Lock Works Company display a few samples which deserve praise for their beautiful and solid work. How much of this, however, was due to machinery could not be ascertained.

Nowhere is the strength of a lock appreciated more than in America, and it is therefore natural that only locks of the best quality are to be looked for.

In fact, locks for doors, trunks, as well as padlocks, and other kinds of locks, are manufactured there on a very large scale, and we must confess that no articles of industry for common use are more apt to be manufactured in large numbers than these.

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GROUP VIII.

SECTION 1.—HOUSE-CARPENTRY.

REPORT BY WILLIAM FLATTICH.

298. UNITED STATES OF NORTH AMERICA.—On account of the great distance of that country, nothing important was exhibited except wagon-wheels displayed by Davis & Sons, of Philadelphia, and Roger, of Cincinnati. The spokes of these wheels were tightly screwed together with iron rings, and they were given an extraordinary strength by this means without using a solid center-piece. Weeks, of New York, also exhibited strong wheels with solid center-pieces.

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INDUSTRY OF WOOD.

REPORT BY DR. JUSTUS BRINCKMANN.

299. Veneers cut with the knife from curled wood—a material which must be treated with great care—were exhibited by Wheeler & Wilson in the department of the United States.

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V.—MANUFACTURES OF SPLIT WOOD.

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300. We will only state that the most excellent wagon-wheels, made of tough hickory-wood, were to be seen in the department of the United States of North America. John G. Davis & Co., of Philadelphia, Charles Weeks & Co., of New York, and the Roger Wheel Company, competed in exhibits of excellent parts of wheels, and wheels of this kind, which are distinguished by their great strength, united with the smallest volume, forming an important article of export from the United States. The first-named firm received the medal of progress for curved parts of wheels.

Prepared wood for musket-stocks, of unusually excellent quality, was exhibited by the War Department, from the United States Armory, Springfield.

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GROUP XI.

Section 3.—Writing, drawing, and painting materials.

Report by Ignaz Nagel.

301. Gold pens.—The first attempts to tip pens with points which resist the corrosive influence of ink were made in the beginning of this century in England. Glass, tortoise-shell, and bone pointed with metal were used as pens. These crude attempts did not succeed well, but they contained the germ of a more useful invention. John Isaac Hawkins, an American living in England, first made tortoise-shell nibs with diamond and ruby points; soon he succeeded in making gold pens pointed with iridium and osmium. The gold pen in its present perfection is made by F. Morgan in London, and has gained a universal celebrity, which it also preserved in the Exhibition of this year.

In America, the gold pen has been introduced by Levi Brown, a watchmaker, and at present enjoys a great popularity. The best establishment for manufacturing of gold pens is without doubt that of Leroy Fairchild of New York. His exhibits contained a large treasure of gold pens, pen and lead-pencil holders, gold rubber-holders, &c. We must also mention James Morton and Ephraim Johnson, who exhibited aluminium pens with gold points of good quality; J. A. Brown & Co. the same kind with diamond points, also specialities, as lead-pencil and penholders of aluminium, mother-of-pearl, &c.

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Section 4.—Book-binding.

Report by Conrad Berg.

302. America was represented in book-binding by only two firms. The Exhibition of 1867 in Paris has already well shown that there are book-binders across the ocean able to perform work which rivals the products of the best firms in Europe.

The books sent from America for the Exhibition at Vienna are certainly faultless; they lack, however, the refined taste and the exactness of work to which former products of book-binding owed a great part of their success. A. Sandford, of Cleveland, sustained victoriously the banner of *green Erin* by his business-books, which were well bound His books are bound in a simple but tasty style, and are so durable that they should preserve on record the debts of all nations of the universe for eternity.

GROUP XII.

Section 1.—Book-printing.

Report by Ludwig Lott.

303. North America.—Although the printers had not sent much, such a quantity of American printing-material was shown that a closer examination would furnish material for a considerable fragmental report.

Besides the exhibits in Group XXVI, the American Geographical Society offered a handsome collection of means of instruction, which, however, did not surpass common excellence, and many of the books were not even printed in America.

Of the other exhibitors, we will only mention those whose products were of importance. The patterns of job and ornamental printing of L. Graham, of New Orleans, indicate the great variety of types which this printing-office not only possesses, but also knows how to make a tasteful use of. Oscar Harpel, of Cincinnati, exhibited a pattern-book, "Harpel's Typograph," which contained a collection of a great number of tastefully-executed patterns of printing in all colors. An example, showing how this active firm attempts to make use of every innovation in the field of typography, is furnished by the portrait of Guttenberg in stigmatotype, which, taken from a stereotype bought at Vienna, had been multiplied by this firm. A galvanoplastic plate, 16 by 21 inches, exhibited by the firm of Schniedewind, Lee & Co., of Chicago, which firm was not mentioned in the general catalogue of the Exhibition, was admirably well executed, and next to the plate exhibited by the Imprimerie Nationale de Lisbonne, the most excellent seen in that department. George Bruce's Son & Co., of New York, exhibited a fine collection of beautiful samples of printing, the composition and execution of which were perfect. This firm has a great variety of so-called penmanship-types, which are for the most part beautifully made. The National Bank-Note Company, of New York, exhibited a collection of postage-stamps, bank-notes, and other papers of value, whose simplicity, beauty, and artistic perfection indicate the high standing of this institution.

Section 4.—Photography.

Report by Joseph Lëroy.

304. America proved, by the photographs of persons and landscapes which it exhibited, that photography is carefully cultivated in that country, and that efforts are made to equal Europe. As to portraits, the photographs of W. Kurtz (New York) were excellent and remarkable, both for their technical perfection and for the refined artistic taste exhibited. They were extraordinarily fine as regards tone and illumina-

tion. The same gentleman exhibited some extraordinary photographs without *rétouche* of the negative. For professional men and amateurs, it was well worth while to examine his photographs more closely, because Mr. Kurtz understands admirably well how to produce beautiful effects by a fine toning and shading of the background.

Very good portraits with beautiful illumination, partly in Rembrandt style, were exhibited by James Landy, of Cincinnati. The same exhibitor also presented some very pretty comic photographs of children.

W. R. Howe, of New York, exhibited good photographs of ladies, (full figure,) with well-executed background. In them we must note the affected and coquettish positions, and the unnatural drapery.

Henry Rocher, of Chicago, and Leon van Loo, of Cincinnati, were also represented with good portraits.

In landscapes, Thomas Heuseworth & Co., Maybridge, and C. F. Watkins, all of San Francisco, excelled. Their pictures were all of a large size, very clear and sharply defined, representing beautiful scenes in fine tone, and making a very good impression.

Charles Bierstadt and Anthony & Co. (both of New York) had sent good stereoscopic views, especially of the Niagara Falls. It is to be regretted that views of important bridges and railroad-constructions were entirely wanting. I know many such pictures from art-stores, and am certain that they are eagerly looked for, especially by engineers.

Excellent reproductions of plastic works, full of effect, (after reliefs of Thorwaldsen,) were exhibited by Unevehr, of New York; and well-executed microscopic photographs, by Henry Rickmann, of Cincinnati.

In all these photographs, silver was used; none of the other processes was represented, although they have been introduced and are used there to a great extent.

I must here mention a new kind of transparent-glass pictures, for the production of which photography acts as an agent. Photographs are produced by means of a layer of gelatine on a glass plate, which is then exposed to the action of Tilghman's "sand blast," a new and highly-admired American invention. In a very short time, the picture appears, neatly and accurately engraved. These transparent-glass pictures produce an admirable effect, and are especially suited for ornament in drawing-rooms, &c. I am convinced that this method will find a great and profitable application in glass industry.

Section 4 and Group XXV *c*.—Lithography and chromolithography.

Report by Conrad Grefe.

305. North America is one of the best customers for imitations of oil-paintings; perhaps one-third of all chromos in oil manufactured in Europe are sent across the ocean to New York, from whence they are distributed by a few dealers over all the States, even to the solitary farms in the far West.

By far the greater part of this export, it must be confessed, consists of what may be called "*Möbelbilder*," (furniture-pictures,) which, executed after exceedingly insignificant originals, and sold at very low prices, have little or no intrinsic value. It is, however, a sign of progress, that so strong a desire for some artistic ornament is evinced in those newly-formed outposts of civilization; for soon other real and more valuable productions of art will follow those pioneers of art.

These remarks do not involve the idea that America consumes no productions of the better kinds. A great number of these are also used, but they form a very small part in comparison with the vast number of insignificant ones.

America does not supply its demand for oil-paintings exclusively from Europe, but it produces a great number itself, and among them specimens which rank with the very best that are made. The extensive lithographic establishment of L. Prang & Co. in Boston deserves to be mentioned first in this respect. Besides old, well-known pictures, this firm also exhibited several new ones, among which especially some marine sketches and *genre* paintings were distinguished by rare perfection, as well in lithography as in printing; they are really exquisite imitations of good paintings.

This establishment also supplies the demands of the public schools with a perfect knowledge of their requirements; they are cared for in an extraordinary manner in North America by the States as well as by patriotic citizens. The pictures of animals and plants, composed in a very instructive manner, are engraved very neatly and printed in colors, and sufficiently prove what has been said.

The establishment of Duval & Hunter in Philadelphia also exhibited a good marine picture full of effect, and several small pictures, very well executed indeed; on the whole, however, these show too much of a desire for producing effects by sharp, dazzling contrasts, and too little care is evinced in the choice of the originals with reference to their artistic value.

GROUP XIII.

SECTION 1.—BOILER-ATTACHMENTS AND LUBRICATING-APPARATUS.

REPORT BY VICTOR NOVELLY.

II.—LUBRICATING-APPARATUS FOR PARTS OF MACHINERY EXPOSED TO THE STEAM.

A.—APPARATUS FOR CONTINUAL LUBRICATION.

306. The Ashcroft patent regulating tallow-cup, made by the American firm of the same name, was exhibited on a machine.

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The whole apparatus is made of red bronze, very massive, and consists of two parts, the oil-cup (a sphere) and the screw-cap. The other parts are fixed to these in such a manner that they need never be taken out.

The main advantage of the apparatus is that it can be replenished with oil while the engine is running, without necessitating the handling of the cumbrous stop-cocks usually employed with other apparatus.

As soon as the cap is unscrewed from the ball, the steam, or, in case the engine is running empty, the spiral spring, lifts a valve and thus closes the communication with the inner cylinder.

In order to regulate the quantity of oil, the upper rod has a graduated disk furnished with a pencil, which thus indicates very exactly the width of opening of the valve.

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SECTION 1.—BOILER-ATTACHMENTS AND LUBRICATING-APPARATUS.

REPORT BY VICTOR NOVELLY.

III.—SAFETY-VALVES.

307. Almost all systems were represented in this class, but all of them in their original construction, without the slightest change. In the American section alone we found a curiously-constructed safety-valve, called "Ashcroft's Patent Nickel-Seat Pop Safety-Valve."

The seat is made of nickel, and the prospectus tells us that it is as hard as steel and as unoxidizable as gold, so that all corrosion is prevented.

The curious construction of this safety-valve consists in its having a hollow semicircular ring on the conical part.

The lower seat of the valve has a corresponding annulus at its top, which is, however, somewhat larger than the one on the valve proper. When the valve drops into its seat these annuli fit into each other.

If the valve is lifted to a slight extent, the steam is momentarily ar-

rested in this spaee, thus produeing a greater pressure and lifting the valve to a greater height. This is a great advantage, espeeially in ease of a sudden production of quantities of steam.

In addition to this, the faee of the valve is thus reduced greatly, and a more effieient paeking is possible.

The valve is kept on its seat by a spiral spring of a square seetion, and can also be raised easily with the hand by means of a lever.

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Weaving-machines.

Report by Johann Zeman.

A.—Looms for smooth and twilled goods.

308. Ross's Ameriean loom for eotton goods contains two peculiarities, one in the shuttle and the other in the arrangement of the driving-wheel. In order to make the velocity of the shuttle independent of the loom proper, it is not put in motion by hubs on the lower shaft, but by springs, in the same manner as that which Schönherr has long employed for his broadcloth-looms. The force of the springs is, however, not supplied by long spirals along the axis, but by a greater number of short wiresprings in a direction perpendienlar to the axis—that is, in the direction of the eoiling of the wire. Such springs are said to be stronger and to last a longer time. The arrangement was, on the whole, very simple, and the loom worked excellently during the short trials which the writer witnessed. * * * * * *

Section 1.—Motors.

Report by I. F. Radinger.

Belts.

309. As is well-known, the quality of belts depends upon the raw material and the proeess of tanning; this report will, therefore, treat of both. In general, no ehanges seem to have been made, and nearly all exhibitors offered belts of familiar appearanee, the samples being generally from 500 to 520^{mm}. (19 to 20 inches) in width.

Reeently the bark of hemlock (*Albies canadensis*) has eome more and more into use for tanning belts in Germany. Belts thus tanned have a red surface, the seetion being white and nearly erystalline in appearance. Such belts are softer, more p'iable, and, in eonsequenee of their fitting eloser to the pulley, they are better for transmission than the stiff belts produeed by the old method of tanning.

The pulleys in the Exhibition earrying such belts retained their dull surface, showing that no slip took place, whieh, however, was probably due to the small amount of power transmitted by them, and it therefore could not be taken as a sign of superior merit. I could not myself test the strength of these belts, nor could I obtain the required information

from others. One of the best manufacturers of leather, whom I asked for information about this method of tanning, rejects it, basing his judgment on the above-mentioned crystalline appearance of the section, which, he said, is due to crystals of tannin; the primary condition for good quality of leather being, on the contrary, a complete extraction of the tannic acid, in order to prevent its deleterious action on the leather. Moreover, he said, the fibers are rather compacted than condensed by that process. Thus the belts are softened but their strength impaired.

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Section 1.—The Motors.

Report by I. F. Radinger.

American engines.

310. The American engines belong to that class of exhibits in a European universal exhibition, which seem most worthy of study, as indicating the experience and views, the execution and style, and the tendency of most distantly-related circles. This is especially true of steam-engines which have been improved, to some extent, by Corliss, and there is very good reason for tracing with interest the innovations in that country.

Unfortunately, America exhibited but little in this division, and only sent one medium-sized engine, besides three small engines.

The insignificance of this exhibition is very unfortunate, but it may be explained by the unlikelihood of making a business in motors in Central Europe and the great cost of exhibiting working machines at an Exhibition in a far-distant state.

In all American steam-engines there was a direct connection between the cylinder and the crank-shaft pillow-block. The two smaller engines, as well as the largest of them, (305 ^{mm}—12 inches—base,) had the cylinder, guides, pillow-blocks, and bed-plate cast in one piece. This is a more hazardous method of manufacture, but it increases the accuracy of work, the rapidity of setting up, and the value and durability of the whole, and corresponds more nearly to the principle of introducing the smallest number of parts, which is also beginning to be introduced with us.

There was little difference between the American construction on the whole and that of European engines. The velocity of the piston, the steam-pressure, size of the parts, and pressure on the journals corresponded exactly to those used in our own country, and the details (with the exception of the frame) even seemed to be a step backward. The regulator was not used to vary the expansion in any of these inachines; they were all made with fixed expansion. None of them had attachments for taking indicator-cards; they were all painted splendidly.

American steam-engines were exhibited by the Norwalk Iron Works,

the New York Safety Steam-Power Company, Pickering & Davis, of Portland, besides several other small steam-motors.

311. THE NORWALK ENGINE.—The Norwalk Iron Works of Connecticut, North America, exhibited the largest steam-engine in the American section. It was a single-cylinder non-condensing engine, with fixed expansion, its governor acting upon the throttle-valve. The cylinder, guides, and pillow-blocks formed a single casting with the frame; the valve-chest was bolted to this at the side and the fly-wheel was cast in one piece.

The bore of the cylinder was 305 mm (12 inches) and the stroke of the piston 0.61 m (24 inches). The normal velocity of the engine was 100 revolutions per minute, corresponding to a velocity of the piston of somewhat more than 2 m (6 feet 8 inches) per second. Its velocity can be easily increased to 120 revolutions (2.4 m—8 feet per second.) The maximum steam-pressure was stated at five atmospheres (75 pounds,) and the engine was rated at from twenty to thirty horse-power.

Subtracting the area of the piston-rod, (50mm—1.97 inches—diameter,) we obtain an effective piston area of 710 square centimeters (109.34 square inches.) The steam-pipe had a diameter of 80mm (3.15 inches) and the exhaust-pipe 100mm, (3.94 inches,) which correspond to $\frac{1}{14}$ and $\frac{1}{13}$ of the piston area, respectively. If we introduce these quantities into the formula $\frac{f_1}{f} = C\,v$, we obtain, with $v = 2$ meters (6 feet $6\frac{3}{4}$ inches) as the velocity of the piston, the constant $C = \frac{1}{2\,8}$, which is very satisfactory, even for low degrees of expansion.

Steam was distributed by means of a piston-valve. The valve-chest had the form of a U, and was bolted to the side of the cylinder. The long piston-valve, of which the form was obtained by the revolution of the common D-valve, and which was packed by metal rings, was moved by a single eccentric. The eccentric-rod did not move the piston-rod directly, but was attached to the detachable upright arm of an oscillating shaft, which again was attached to the valve-rod nearer the cylinder. This shaft crossed below the frame of the engine and had a somewhat larger head at the end farthest from the steam-valve, with small holes for the attachment of a hand-lever, by means of which the engine could be started or stopped quickly.

The feed-pipe and the exhaust-pipe both joined the steam-chest at half their length, the one above, the other below. A Pickering governor, driven by a belt, was placed immediately upon the upper steam-pipe. This governor works the register-valve, which became known at the Paris Exhibition, and thus regulates the steam-pressure. There was also a simple lubricator of elegant construction. The steam was led below the flooring to a vertical pipe, passed through a common throttle-valve, having a horizontal spindle, to an elevated turn in the pipe, where the Pickering governor was placed; thence it passed outside

of the pipe-housing, through a passage which terminated at the two ends of the steam-passages, and from here it entered the engine as permitted by the position of the piston-valve.

The exhaust took place through the central passage of the piston-valve, which communicated continually with the atmosphere by means of the middle pipe. By this arrangement the steam-passages are made shorter, for the distance of the axis of the cylinder from the axis of the valve was no more than 350^{mm}, (13.8 inches;) the difficulties of the otherwise complicated castings were obviated, and the whole execution of the work was facilitated, as it was all cylindrical.

The main frame, placed at the side and in a line parallel with the axis of the cylinder, was bored at one operation for the guides, and contained the crank-shaft bearing at the front end. This was set at an angle of about 30°, like the outboard fly-wheel journal. It was merely formed in two parts, without wedges, but with an overlapping cap. The nuts of the four cap-bolts were secured by set-screws. The feet had the old Gothic forms, which we have long since abolished, and which are, therefore, unusual with us. They were also found in the other American machines, and are considered handsome when combined with rococo painting.

The frame was also supported in the middle of its length (at the end of the guides) by an additional foot.

The cast-iron cross-head held the piston-rod—50^{mm} (1.97 inches) in diameter—in the usual manner, by means of a gib and key. In front it separated into two sides, which took hold of the end of the connecting-rod by means of a pin passing through it. This pin, which is 65^{mm} (2.56 inches) long and 45^{mm} (1.77 inches) in diameter, bears a pressure on its surface of 122 kilograms per square centimeter, (1,800 pounds per square inch,) the total pressure of the steam—3,650 kilograms (8,760 pounds)—upon the piston acting upon a sectional area of not quite 30 square centimeters, (4.62 square inches.)

The guides were 240^{mm} (9.45 inches) long and 90^{mm} (3.57 inches) wide, and were bored out of line with regard to the cross-head pin, which facilitates their construction and that of the frame, by shortening it, but which is wrong, on the principle that, if possible, all strains are to be resisted directly. They were faced with bronze both above and below, and had two wedges to hold them. The pressure on them was 3.4 kilograms per square centimeter, (60 pounds per square inch.) This pressure is one of the highest occurring in engines with flat guides, and was only surpassed by three engines at the Exhibition to a small extent. The adjusting-apparatus is fully justified by this and the greater velocity of piston.

The crank had no counter-balance, and was made of the common form and of cast iron. It was fitted close up to the journal, and had a steel crank-pin, 60^{mm} by 100^{mm}, (2$\frac{3}{8}$ by 3.94 inches,) keyed into it. The connecting-rod holds this pin somewhat eccentrically. The

pressure between the pin and its bearing was 61 atmospheres, and the work of abrasion per square inch in one second, assuming the co-efficient of friction to be $\frac{1}{20}$, becomes 4.095 foot-pounds

The journal was long—210^{mm} (8.27 inches) with a diameter of 125^{mm} (5 inches)—and could readily be made so as the steam-passages were made short, nevertheless, by the application of the intermediate lever. The horizontal pressure between the pin and its bearing, due merely to the pressure of the steam, is 14 kilograms (33.6 pounds) per square centimeter, (0.154 square inch,) and the work of abrasion is 1.98 foot-pounds per square inch.

The fly-wheel had a diameter of 2.60 meters (8 feet 8 inches) and was 400^{mm} (15$\frac{3}{4}$ inches) wide, forming the pulley for the belt, which was 300^{mm} (11.8 inches) wide.

The section of the fly-wheel rim was of E-form, and the exterior surface was slightly swelled out. The rim, the six arms, and the nave seemed to be a single casting, without hoops shrunk upon it.

The governor-belt was driven by a pulley which was made in one casting, with an intermediate tube and the eccentric, and was keyed upon the shaft, which was 140^{mm} (5$\frac{1}{2}$ inches) in diameter.

The whole engine worked smoothly, and rested upon a light foundation of bricks, whose exposed parts were cased in wood made to imitate stone.

The cylinder and the other stationary parts were cast plain—that is, without a steam-jacket—but it had a silver-plated casing. The small amount of radiation from this casing, as compared with that of the tin-cased steam-pipe, was sensible to the touch. Waste-pipes were also added, ending in symmetrical pipes attached to the exhaust-pipe.

The execution was good, without exhibiting the unnecessary elegance to be seen in other American machines, which had nickel-plated wheels, silver-plated nuts, &c. The lubricators were an exception; they were made of ground glass and real bronze, ornamented with eagles, and neat dark-green painting. These simple golden ornaments were used wherever there was a convenient place, even upon the crank and the wheel.

THE SAFETY STEAM-POWER COMPANY OF NEW YORK.

312. The Safety Steam-Power Company of New York exhibited two small upright engines, one of which was rated at six horse-power and the other at two. They were both of the same construction, and consisted each of a hollow upright base, with journals cast in them below and with the cylinder at the top. The guides on the uprights and the valve-chests on the cylinders were also cast on the frame, and the ensemble presented a very pleasant form.

The cylinder of the larger had a diameter of 200^{mm} (7.87 inches) and a stroke of 300^{mm}, (11.81 inches.) The guides were also cast on the uprights and were bored; the cross-head had two wedge-shaped brasses, adjustable by set-screws. The crank-shaft seemed to be made of cast

iron, and was reduced in size immediately at the inside of the journals, while at the outside it carried a turned fly-wheel on one side, and a small pulley, 1.06 meters (— inch) in diameter, on the other side. These were interchangeable.

The valve-gearing consisted of an eccentric, whose rod was jointed to an intermediate lever nearer to the axis of the cylinder, and a plain D-valve. The valve-chest cover of the smaller engine was also round. A Pickering governor was placed above the steam-pipe on the valve-chest, and acted directly upon the throttle-valve in the usual manner.

These upright engines were each mounted on a cast-iron base, whose heavy cubical form showed off the light form of the upright frame in the best manner; it also raised the shaft so high that there was no necessity for a fly-wheel pit.

One of the engines was made in the usual manner, while the other did not show a single bright surface that was not silver-plated, and it was covered with painted decorations *à la* sewing-machine.

PICKERING & DAVIS, OF PORTLAND.

313. Pickering & Davis built their small six-and-a-half horse-power engine of a large number of separate pieces, as if this were considered a triumph or a guarantee.

A steam-cylinder, with high feet, was placed upon a cup-shaped bed plate, while two separate pillow-blocks were bolted to it in front, carrying the fly-wheel between them in the axial line of the cylinder. The straight shaft was moved by two cranks, which were placed similarly and symmetrically upon it outside of the bearing, and were moved by two connecting rods. These came from the outside of a flat cross-head, to the center of which the piston-rod was attached. The guide of the cross-head consisted of four wrought-iron bars, which were attached in pairs to the front cylinder-head. At their front ends were attached set-screws, each of which had a corresponding hub cast on the crank-shaft pillow-block. The set-screws passed through holes in these hubs and had nuts on their ends, by means of which the cylinder and the journals could be drawn into one plane. The journals were made of two pieces each; they had four bolts to each of their overlapping caps, and their feet were of the Gothic form.

The guides were placed very far apart—210^{mm} ($8\frac{1}{4}$ inches) from center to center—and the fly-wheel almost touched both of them. The hub of the latter touched the journals, so that the shaft could not be seen.

The outside diameter of the fly-wheel rim was 1 meter, (3.28 feet.) It contained a groove fitted for a peculiar kind of belt, which had a width of 160^{mm}, (6.3 inches.) This belt was treble. Small pieces of leather, with three larger strips cut to correspond with the form of the groove, were spaced 70^{mm} apart ($2\frac{3}{4}$ inches) from center to center. The mean width of each of these leather wedges was 50^{mm}, (2 inches,) and these were fastened by two rivets each—35^{mm} ($1\frac{3}{8}$ inches) long—passing through all the seven layers.

This belt, which was used in order to be able to transmit the motio of the small and narrow fly-wheel effectively, attained its object pe fectly, and the dull lines in the groove indicated that no sliding too place The soft-leather wedges are pressed into the wedge-shape groove, and since the friction does not occur at a cylindrical surfac but at the sides of diverging walls, where slipping could only occur wit different velocities, it fulfills its purpose better than it otherwise could

Th valve-chest was bolted to the top of the engine, and the steam pipe was placed in the center of the polished valve-chest cover.

The valve was moved by an inclined eccentric-rod; its motion wa changed by a rock-shaft oscillating in the vertical plane on an axi which was placed on the top of the straight guides.

The iron piston-rod and connecting-rod were not turned, but simply cold-rolled, by which means the surface is hardened and resists abrasion better. The rods were cylindrical, and the packing, set up with screw caps, remained tight, which, however, is no special merit.

A Pickering governor was, of course, attached to the feed-pipe; th engine was furnished with steam-chest lubricators, and the bright surfaces seemed to be silver-plated.

The cylinder had a bore of 152 mm, (5.98 inches,) and the stroke was 305mm, (12 inches.) It worked at the rate of 165 revolutions, which corresponds to a velocity of piston of 1.66 meters (5 feet 5 inches) per second. The wrought-iron feed-pipe had an inside diameter of 35mm, ($1\frac{3}{8}$ inches,) and the exhaust-pipe 40mm, (1.57 inches.) The steam-pipes were fitted with sharply-turned elbows serewed to them, and they appeared like inexpensive gas-fittings.

SMALL ENGINES.

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314. SELLERS'S ENGINE.—Sellers's revolving puddling-furnace was furnished with a small steam-engine, of which the simple reversing-gear deserves mention. The crank-pin had a collar placed upon its free end, and outside this a reversed crank for the eccentric-rod, which was adjustable in position. The collar had a flat hub containing two notches, and the eccentric-crank was furnished with a handle and a spring locking-apparatus. By inserting this apparatus into one or the other of the notches, the eccentric-crank is set for the forward or the reverse motion.

If, now, the engine was almost stopped by closing the steam-valve, reversing could be performed quickly and easily by a short motion of the hand, and this detail seems to be one of the simplest imaginable for the frequently neeessary purpose.

SECTION 2.—WOOD-WORKING MACHINES.

REPORT BY DR. W. F. EXNER.

315. Baxter D. Whitney, of Winchendon, Mass., exhibited a band-saw in the American section, stretched by a spring and having a very inter-

esting form of guide, formed by two small blocks of wood placed at an angle to each other, and bisected by the blade of the saw.

These blocks have holes drilled through them, and are lubricated with machine-oil. The oil is dropped upon the small guide-roll, at the back of the blade, by means of a piece of cloth, and is thence transferred to the blade itself.

Another peculiarity of Whitney's band-saw, in addition to an interesting arrangement for adjusting the upper pulley, is the fact that the spokes of the pulleys do not lie in the plane of the periphery, but form a curved hollow surface of revolution, whose axis coincides with that of the pulley. The position of the spokes resembles that of the wheel-spokes of our wagons, this being also a conical surface.

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The Whitney planer, which is one of the boldest and most curious of American machines, has already become known to the professional public by the Paris Exhibition. (Official report of the Exhibition, H. B. S., 246.) It will, however, probably not be superfluous to remark that Whitney's smoothing-planer is intended for smoothing a given surface without changing the main form of the piece of wood. It is limited to removing a thin layer from the surface, and in doing this it follows the form already given the piece. Whitney also exhibited a peculiar, excellent plane-iron sharpener.

316. The excellent machines of C. B. Rogers & Co., of Norwich, Conn., which were remarkable especially on account of the arrangement of the axes of the cutters and the feed-rollers, were also exhibited at the Vienna Exhibition, without receiving such attention from the public as they certainly merited. Further information relating to them may be found in the Report of the Paris Exhibition, by Scharff, and in the work of Richards.

V.—Mortising and splitting machines.

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317. Ignoring theoretical difficulties, the Americans, who are accustomed to meeting obstacles by seemingly extravagant arrangements, have repeatedly undertaken the improvement of mortising-machines. From a reliable source we learn that three American manufacturers alone have sold 2,500 mortising-machines within the last fifteen years.

There are several different systems of mortising-machines, based upon different principles. Among others, the firms of Lane & Bodley, of Cincinnati, and Richards, London & Kelley, of Philadelphia, deserve credit for their efforts made for the improvement of these machines. The latter firm represents the later kinds of mortising-machines brought out since the year 1860, and we will briefly describe these machines here.

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The simplicity of the tool-motion allows of rapid motion for any length

of time. The table is very heavy, and hence it arrests the blow without re-acting on the foot, which raises or lowers the table by means of a foot-lever. This simple arrangement has the best chance among all mortising-machines of lasting individually, and thereby perpetuating the life of its class.

This principle, seen in these mortising-machines, received valuable and characteristic assistance by the addition of an ingeniously-invented reversing-device for the chisel. An American engineer, Smith, of Lowell, patented this device in 1854. It was first described in the Journal of the Franklin Institute in 1870, and was exhibited in 1873 at the Universal Exhibition, in a mortising-machine of Allen Ransome, built after the patent of Richards's original machine.

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VI.—Combined machines.

2. Combined machines for special purposes.

318. Special interest was deservedly manifested in a complicated molding and boring machine, invented by Mr. Knapp, of Northampton, Mass., and used for producing dovetails in two boards placed at right angles to each other, either in a box, a table, or bureau-drawer. The joints are everywhere tight and elegant, so that they are as well suited for the best furniture-work as for boxes. It is said that the Russian government is making experiments to determine whether these boxes are suited for the transportation of gunpowder. If, moreover, the American walnut and whitewood are used for such a joint, a very pretty ornamentation of the outside of the box is also secured. These two kinds of wood are, moreover, the best ones for working by this machine. One of the boards is worked by a cutter, the other, at the same time, is worked at a corresponding place by a drill and three chisels, cutting out a semicircle. Knapp's "American dovetailing-machine," which received the first prize at the Cincinnati Industrial Exhibition in 1871, costs $460 in New York, and works as fast as ten men making an ordinary dovetail-joint.

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319. We also admired Woodbury's brush-making machine. Very accurately-drilled brush-backs brought from America were used in this machine. As our curiosity was not satisfied in this regard, it was also disappointed with regard to a shoe-machine in the American section. This machine cut the pegs, of German form, from a ribbon of maple sharpened on one edge and rolled up spirally, and immediately drove them into the shoes. In this case also we would have liked to study the unknown auxiliary machine which supplied the material used.

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Section 2.—Fire-engines and pumps.

Report by Peter Zwiauer, Engineer.

320. Another remarkable appearance in the American department were the Mintzer pumps, which were constructed in a very original manner, and were specially adapted to pumping thick and impure liquids.

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The pumps which were displayed at the Exhibition had a very small height of suction, and did not force the water at all, working very well, however. How the efficiency of the pump will rate when it is used for greater heights remains to be determined. Since the pistons have no packing against the sides of the cylinder, but India-rubber strips are merely fitted as closely as possible, it is self-evident that losses of efficiency must always occur. The pumps are very well adapted to pumping impure fluids, since no damage can occur to the piston or the valves by their becoming loose. It is said that they have been adopted by the American Navy.

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Section 2 *a*.—Spinning-machines.

Report by Johann Zeman.

321. Avery's drawing mechanism was a remarkable and very promising apparatus in the American section, not so much on account of the drawing apparatus, which imitates the action of a mule, as on account of the excellent arrangement of the drawing-cylinders.

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Section 2 *b*.—Sewing-machines, knitting and embroidering machines.

Report by Carl Cohn.

322. The greatest sewing-machine manufactory of the world is that of Wheeler & Wilson, in New York, which firm has already put 900,000 sewing-machines into the market. The wholesale manufacture, with its "division of labor," is arranged in such a manner that every machine in the market can be entered as an article for exhibition. This firm already produces 600 sewing-machines daily. It has started a thread mill to supply thread for its machines, and has formed over 100 sewing-schools, in which machine-sewing is taught gratuitously, merely for the purpose of spreading a knowledge of machine-sewing among all classes of people in all countries.

This firm has also invented the button-hole attachments, which are now used very generally.

The latest invention of this firm, and one which was admired at the Vienna Exhibition, was its sewing-machine No. 6, which has been devel-

oped experimentally within six years, and at an expense of $200,000. This universal machine sews the strongest leather harnesses and the finest gauze with a scarcely-perceptible pearl stitch.

Wheeler & Wilson received highest prizes at all universal exhibitions, and were also distinguished at Vienna. General agencies are to be found in all the principal cities of Europe, as well as of America.

The American firms of Howe, Singer, Secor, and others also furnish machines according to one of the two above systems, as well as some English, French, and German machine shops also build them.

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Another attempt which has been made, to take the knitting-needle from the hands of the women and girls, and to replace their knitting by machinery, has led to some favorable results, especially in America, although the spirit of invention has not yet produced the very best in this line.

Besides our old stocking-knitting loom, invented by William Lee, of England, in 1589, Dalton, of New York, has first constructed a heavy-knitting machine, in 1862, a circular loom for various knitting-materials. Then Lamb of New York has invented a complete knitting-machine, which produces stockings of any size by the aid of 120 needles.

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Section 2.—Wood-working machines.

Report by Dr W. F. Exner.

IV.—Lathes.

323. From the sketches by I. L. Kipling, of the Sir Jarnset Jee Jejeehoy School of Art and Industry, Bombay, illustrating various methods of manufacture, and from an inspection of the Boutique in the Palace of the Khedive, we see that only one manner of turning is practiced in the East. The workman sits upon the floor and rotates the work, which lies upon some very primitive carpets, with his foot, while the other workman assists it and holds the tool in his hands. What an immense contrast is there between this primitive method and Baxter D. Whitney's patent gauge-lathe, a plain turning-lathe, in which the machine automatically lowers and sets into action various tools of different forms, after having turned the piece off roughly.

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Section 3.—Agricultural implements and machinery.

Report by Anton Adam Schmied.

324. America, as well as England, exhibited plows which were distinguished by good construction, good workmanship, and beautiful finish. Only a few firms exhibited, and these to but small extent, but what they exhibited was excellent; thus the well-known Remington plows of

the firm of Wood, of Warder Mitchell & Co., the various plows of Deere & Co., having medium long or long mold-boards, and long, wide shares; swing plows, one of them furnished with a cutting-wheel, which is very much in favor in America; and especially the plows of Collins & Co., which represent, with commendable exactness, the American form of plows. The two-wheel plow exhibited, however, with an elevated seat for the driver, seems to be too complicated to be recommended for common use. The plowman here does not walk behind the plow, but is seated rather high above it; by means of a lever attached to it he lifts and lowers the plow.

How indefatigable Americans are in continually inventing new implements, is best proved by the American plow with rotary mold-board, exhibited in the pavilion of the department of agriculture. This rotary mold-board is made in imitation of the action of the mole in turning up the ground. It is a plow with adjustable mold-board, which rotates while the plow is drawn, loosening and crumbling the soil so that it resembles garden-soil.

The English and American plows are nearly all strongly built, entirely made of iron, and very heavy; as a rule they are strong plows, for which reason they require more skill and power than our common plowmen and teams can give to them; most of them are adjustable to a depth of from 10 to 12 inches a furrow, which is far from being common with us. In addition to this, taking their high price, we find a reason why these excellent implements do not find that application which is to be desired in our country. But compared with each other, these plows show great differences. The English plows are flat, turning with a long mold board of medium height, and long horizontal handles, while the American plows have usually a steep mold-board of medium length, chisel-pointed shares, short, bent beams, and high handles.

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SOWING-MACHINES.

325. America exhibited only one sowing-machine, a drill, for two horses exhibited by Thomas Ludlow & Rogers of Springfield, called "Superior." It was furnished with telescopic tubes for conducting the grain. By simply closing the small conductors and opening the large ones, it may be adjusted for all kinds of large seed as well as for small. It is also furnished with an arrangement for the stopping of the machine momentarily. The machine is durable; its general outfit is beautiful; the material is of the best quality, and the workmanship is first-class.

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MOWING-MACHINES AND HARVESTING-IMPLEMENTS.

326. While at the first Universal Exhibition at London, 1851, the Americans, McCormick and Hussey, exhibited the first really valuable mowing-machines, those of the Exhibition at Vienna made an impression by their variety and by the perfection of their construction.

The American mowers stand above all others, and among them are

the grass and grain mowers of Walter Abbott Wood, Hoosic Falls, N. Y. Wood's mowers gained the favor of the farmers quite early; for, while during the year 1852 only 200, and in 1853 only 300 mowing-machines were manufactured, the number of mowers produced in 1872 was 17,079, and during this whole space of time this firm built and sold no less than 166,468 mowing-machines.

327. The "New Champion" of Wood contains essential improvements. The greatest fault of the old Champion consisted in its weight. The Continent demands a light, and, at the same time, strong and durable machine. To supply this want the New Champion for 1873 was produced by essentially improving the old Champion. It being impossible to lessen the weight, and retain the open wheel without spokes, without impairing the strength of the machine, a novel kind of wheel has been applied. The mechanism, however, has been arranged in such a manner that the cutter-bar is still in a line with the axle of the wheel. The New Champion is a one-wheel machine, the main wheel being 3 feet in diameter and 8 inches in width. Little can be said about the cutting-apparatus of the machine, this having attained such perfection that it answers all practical purposes. The fingers of the Champion are made of wrought iron covered with steel, and open at the back in order to admit the knife for cleaning. The height of the cut can easily be regulated by an adjusting apparatus; the points of the fingers are easily raised or lowered by the driver from his seat, in order to gather the grain which has been cut, and to pass over obstacles. The driving-gear is strong and durable, easy of access, and covered by a box to keep off straw and dirt. Every machine is accompanied by four rakes, two of which may be used as beaters when they are not used as rakes. The revolution of the rake has been extended, and the platform, rigid and well secured, has been enlarged, by which means a wide and clear track for the horses has been procured. On all bearings patent lubricators are used. The New Champion only weighs 9 cwt. 12 lbs., and the whole machine is most carefully made. The balance is perfect, without any inclination to one side, and without oscillation. In short, the New Champion is matchless as regards strength and in perfection of cutting, in depositing the sheaves, in facility of draught, and in general simplicity.

Wood's "New Iron Harvester" has the draught underneath, being attached to the frame instead of the axle, by which means all weight is taken from the horses, and the cutter-bar is enabled to pass over every obstacle. It is one of the most solid and useful machines ever made. Its neat and pretty appearance, its ease of draught, and its convenience and reliability as regards work soon gained it many friends. First introduced in 1871, more than 6,000 machines were made and sold in 1872.

Wood's grass cutter has attained such perfection that it answers all requirements. Its construction has been developed so much that only

a few unimportant differences are perceptible between the present machine and the one exhibited at Paris in 1867.

Finally, the firm of Wood exhibited a reaping and automatic binding machine; that is, a reaper with a contrivance for binding the sheaves attached to it. The machine bore the inscription, "L. D. Locke's Harvester and Binder," and excited considerable interest. It was very heavy, and its construction seems, as yet, a mere idea. It certainly will take a long time before the problem of binding the sheaves by machinery will be solved successfully.

This problem has been attempted in America for several years, and several apparatus have been constructed in which a laborer, sitting on the machine, binds the sheaves formed, with wire supplied from a reel mounted beneath the cradle, and tips the sheaf from the binding-table into the stubble; but none of them have, as yet, been practically successful. In Wood's automatic binder the grain, as it is cut, falls upon a continuously moving, side-delivery, elevating carrier, and is delivered into the cradle or receptacle, where a wire is tied around it by means of a lever, which binds it into sheaves. But this apparatus also requires essential improvements before it will answer all requirements.

328. Marsh, Steward & Co., of Illinois, also exhibited a reaper with automatic binder.

The "Champion," a reaper exhibited by the firm of Warder, Mitchell & Co., Springfield, Ohio, fully equals that of Wood. The frame of the machine is made of wrought iron, which gives it an extraordinary strength and durability, with little weight, and, therefore, answers all practical requirements. The cutting apparatus is attached behind the driving-wheels, moving with the platform, and adjusting itself easily to the unevenness of the ground.

The self-raking device in this machine is simple, light, and strong; it is easily fastened to the machine by two screws, and is driven by chains; thus all complications and tooth-wheels are avoided. By means of a novel device for raising and lowering the knife, the driver, in his seat, adjusts the cutting apparatus where the grain is entangled and prostrated. The guard-fingers are made of solid pieces of iron or steel, and are hardened at the surface, the central portions remaining soft and tough. Warder's combined grain and grass mower, "Champion," differs from Wood's machine by being two-wheeled. With regard to the preference of one-wheeled or two-wheeled machines, opinions as yet differ. The one-wheeled machine adjusts itself to the unevenness of the ground without changing the draught-line, and is therefore adapted to an uneven surface; it has, however, a considerable side-draught. The two-wheeled machine, on the other hand, has a steady motion, the resistance is distributed equally, and the machine has little tendency to turn into the grain. It is especially adapted to a level surface.

Many farmers are, therefore, in favor of the two-wheeled machines,

as may be concluded from the fact that more than 12,000 Champions were sold in 1872.

The Champion grass-mower of the same firm has an equally excellent construction. Having a wrought-iron frame with a fixed wrought-iron axle for the driving-wheels, and a wrought-iron connecting-rod between the cutter-bar and frame, this mower combines the greatest possible durability with the least weight. When in use, the finger-bar can be lowered so far that the grass is cut close to the ground, or raised high enough to pass over stones or other obstacles. The workmanship of both machines is faultless.

329. The Buckeye combined grain and grass cutter also occupies an honorable position. Produced, for the first time, in July, 1857, during which year 25 were built, the firm of Aultman, Miller & Co., Akron, Ohio, by which the machine was invented, manufactures 20,000 of them annually, which are sold in the United States. The Buckeye was the first machine with two driving-wheels. It has a cast-iron frame with wrought-iron supports; the cutting-apparatus can be folded so that it rests safely and firmly on the frame in a horizontal position, which is very convenient for transportation. The cutter-bar is adjustable; the fingers are made of the very best wrought iron; and the sheath, which is covered with steel, has a grooved surface, in consequence of which the friction of the knife, the edge of which is well hardened, is considerably lessened and the draught is diminished. The material of the machine exhibited was of the best quality, and it was well constructed.

330. Adriance, Platt & Co., of New York, also exhibited faultlessly-built Buckeyes, and designated this grain and grass mower as the best and most popular machine of the whole world. The self-raking apparatus of the Buckeyes, the simplified and improved Johnson self-raker, is simple, durable, and very effective, whether the grain be short or long, wet or dry. It contains only three very strong pieces, being made of malleable cast iron; all the rest of them are made of the very best wrought iron. In this and all the other reapers we have thus far mentioned, the depressing-apparatus is arranged in such a way that the revolving rakes, after having passed the platform, take a nearly perpendicular position, not surmounting the level of the driving-wheel. Thus the driver is not troubled by it.

331. Cyrus H. McCormick, of Chicago, Ill., exhibited his reapers and harvesters, which are, in all their parts, excellently constructed. McCormick must be considered as the real inventor of the mowing-machine, for he was the first to build a really useful machine. He exhibited his machine first in the London Exhibition of 1851, after having toiled for twenty years before he succeeded in getting his machine in such form that it accomplished the work successfully. The original machine of McCormick was later improved and modified by an endless number of inventors. The original machine, with its improvements, was, however, not displaced by them; for more than one hundred thousand of these

machines have been sold in the United States. The principle of McCormick's machine is so generally known that a description of it may be dispensed with. The only thing worth mentioning is that the weight of the machine has recently been reduced by nearly three hundred weight, by an extensive application of wrought iron, especially for the reel-frame, and by a diminution of the diameter of the driving-wheel. The new machines weigh only a little more than ten hundred weight. The rakes move quietly; the lubricating-apparatus consists of glass bottles covered with ground-iron lids, which are constantly supplying to the journals the oil necessary for lubrication by means of a wick. Recently they have been closed by screw-caps, which completely prevent the entrance of dirt.

332. D. M. Osborne & Co., of Auburn, N. Y., exhibited two fine one wheeled mowing-machines—one for grain, and the other for grain and grass combined; and with these a two-wheeled grass-cutter, "Kirby," which, in America, is considered one of the most excellent mowers. The frame of this machine is made of the best American material, light, and, at the same time, solid. The fingers have steel plates riveted to them; thus the grass is sheared off, not pinched off as with other machines. The reaper called "Burdick" has proved efficient in many competitive trials. The combined reaper combines both systems in an efficient manner.

333. The "Excelsior" reaper, exhibited by J. F. Seiberling & Co., of Akron, Ohio, differs from all the rest of the American mowers in the depressing-apparatus. * * * * This is the only American mowing-machine in which it is effected by a treadle. But, as it is only done at the rear, the hand must be applied to move the grain to one side, in order to clear the track for the next round of the machine. The advantages of this, in many respects, excellent machine will thus be considerably diminished in many cases. It must also be mentioned that, in the "Excelsior," the reel is adjustable in such a way that it can easily be elevated or lowered by the driver, according to the length of the straw. This is a very great advantage, especially in windy weather and for prostrated grain; the stalks become erect, and cutting off the heads is avoided. The mower exhibited by this firm has, like the last-named reaper, two independent wheels of large diameter, (33 inches,) which carry the frame. They are loose upon the axle, and drive the axle only by means of two clicks and a ratchet fastened to the axle Thus it becomes possible to cut in turning ever so short, since one wheel is sufficient to operate the machine, the other being necessary for turning. On the whole, this machine is well built and has attained a pretty extensive sale.

334. The Johnston Harvester Company, of Brockport, N. Y., exhibited Johnston's wrought-iron, two-wheeled mower, which has, in its latest construction, such an arrangement and execution of the single parts, that it can be used under the most various circumstances. It is

made in an exemplary manner. Facility of draught and the movability of the cutting-apparatus—attached to the frame by a jointed connecting-rod—render it fit to be used even in very rough meadows. Johnston's harvester and grain-mower was introduced into Europe only four years ago, and has already acquired a great popularity in spite of much opposition. It is one-wheeled, neutralizes the side-draught by a correct adjustment of the shaft, and is distinguished by enabling the discharge of four different sizes of bundles, according to the quality of the grain, by the application of different cog-wheels and the use of the foot-board beneath the seat of the driver. The combined mower and reaper is mounted on high wheels, with broad tires, in consequence of which it is distinguished by an easy and steady motion.

335. Finally, the Mowing-Machine Manufactory of Wheeling, W. Va., exhibited its "Superior," the novel American grass-mower, distinguished by its simple construction, facility of draught, and convenient manipulation, using neither an intermediate shaft nor gearing; the power being transmitted directly from the main-shaft to the crank-shaft with the least amount of friction and little danger of fracture. Its capacity, also, is very great, for it cut one "joch" (1.4 acres) of mixed fodder, in Leopoldsdorf, in one hour and seven minutes, although this test was considered unsuccessful.

336. The Sprague Mowing-Machine Company, of Providence, R. I., exhibited two mowers of very simple and light construction, and well balanced. This mower belongs to the class of two-wheeled machines having the cutting-apparatus attached at the right side in front of the wheel-axle. The frame is made of cast iron, and all parts of the driving-gear are well protected from dirt. The finger-guards are supplied with steel plates, which, however, is not considered any advantage at all by many farmers. The correct fitting and solid fastening of these plates causes a great deal of work, and their getting loose produces many inconveniences. The cutting-apparatus is manipulated by the right hand of the driver by means of a lever, and is in this way easily adjusted to the unevenness of the ground.

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Section 5.—Means of transportation.

Report by M. B. Riddi, Engineer.

337. The wagon-manufacturers of the United States of North America exhibited two wagons at the Vienna Universal Exhibition, while they had sent three to the Paris Exhibition of 1867.

The Kimball Manufacturing Company, of San Francisco, sent a one-horse wagon, which is known in California under the name of "buggy." The front wheels have a diameter of 1.140 meters, (45 inches,) the hind wheels 1.260 meters, (50 inches;) the distance between the centers being 1.450 meters, (58 inches). All the parts of the wheels were made of hickory wood, (caryaalba.) The axle-bars were made of ash and had

a length of 1.140 meters (45 inches) between the naves of the wheels, being firmly attached to the wrought-iron axles by several clamps. Above the axle-bars were two perches made of polished ash 35 millimeters ($1\frac{3}{8}$ inches) thick, being each connected to a spring-strap 15 millimeters (0.6 inch) thick, into which straps the box is hung. The neatly-constructed box, with a single seat, was made of maple. Its length was 1.2 meters (48 inches) and its width 0.57 meter, (22 inches.) In spite of its lightness, this "buggy" showed great strength in all its parts.

338. The Tubular Barrow and Truck Manufacturing Company of New York exhibited a wheelbarrow suitable for transporting earth. It is made completely of iron, its weight being 75 pounds, and its capacity 3 cubic feet.

Parts of wagons were exhibited by Charles Weeks & Co., of New York. They exhibited 12 complete wheels without tires, and of various diameters. Its rims, spokes, and naves were made partly of oak and partly of hickory.

John Raddin, of Lyon, Mass., exhibited wagon-wheels with alternate wrought-iron spokes placed upon the naves.

339. The Mowry Axle and Machine Company, of Genesee, N. Y., exhibited an apparatus for shrinking tires upon wheels. In the course of the exhibition it rapidly repaired the wheels of the wagon which had been damaged by their use within the Exhibition.

The Union Spoke Works, of Philadelphia, exhibited naves and spokes of hickory, as well as a large number of rims, each of which formed a semicircle.

340. By far the most important exhibit of parts of wagons from North America was that of the Royer Wheel Company, of Cincinnati, Ohio. Its specialty is the extensive manufacture of wheels and parts of wheels. A species of wheels, the Garvin patent wheels, seems to have gained the greatest favor at present, since the above-named factory alone sold 32,000 sets within the last five years.

The twenty patent wheels exhibited by the Roger Wheel Company had a diameter of 1.260 meters, (50 inches;) diameter of bore of the nave, 25^{mm}, (1 inch;) diameter of the nave, 70^{mm}, (2.8 inches;) thickness of the spokes, 20^{mm}, (0.8 inch;) thickness of the rim, 25^{mm}, (1 inch;) width of the rim, 20^{mm}, (0.8 inch.) Each wheel has 14 spokes, which are held to the nave by two flanges of malleable cast iron.

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GROUP XIV.

Section 4.—Surgical instruments.

Report by Dr. M. V. Moorhof, Dr. Hans Adler, Dr. L. S. Chrötter, Dr. Moritz Benedikt.

DENTISTRY.

341. Artificial teeth and sets, of excellent material and exquisite workmanship, were exhibited by America, (S. S. White, H. D. Justi, and Dr. Allen,) and by Dr. Ash, of England. The French teeth, by Dr. Devillemur, were, on the other hand, of inferior quality, but cheaper. They differed by their saturated color. The usual pivot-teeth, as well as artificial teeth with roots, were to be seen in the American section; the latter are for sets of continuous gum, a mass resembling porcelain, by which the color and the appearance of the gum are well imitated. The pieces with teeth in irregular positions are new, but of little practical value. To produce more complete deception, they contain gold fillings.

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We should mention the following as innovations in instruments and auxiliary apparatus for filling teeth:

Steel plates (by S. White) as walls, if the inside of the tooth which is to be filled is very defective and the neighboring tooth is still in its place. These plates are substituted for the walls of the teeth by being inserted between them during the process of plugging. They enable the process to be carried on rapidly and with precision, and are removed after the filling has been accomplished.

342. Green's electric burring engine, by S. White. Under this name we find two kinds of apparatus, a drilling-machine and a plugging-machine, which are both driven with great force and rapidity by means of electricity. The drilling-machine, which has a rotary motion, can be used with any drill, but it can only be employed for cavities that are on the outside of the tooth. The instrument is applicable to a very slight extent to cavities on the side of the tooth. The plugging-machine has a vertical, striking motion, and can also take mallets of any form. Whether this apparatus is better than the simple or the automatic plugger heretofore employed, can only be determined by experience. The drilling-machine is, however, only safe in the hands of a very skillful operator.

Dental instruments, such as forceps, drills, pluggers, &c., all nickel-plated, were exhibited by S. White and Dr. Ash, in new and improved forms. As regards their external appearance especially, and in their great variety, they exceed those of the Paris Exhibition. As deserving special attention, we will mention the new nerve-instruments of Messrs. Palmer & Arrington.

Dentists' chairs were exhibited by S. White, O. C. White, and Dr. Ash, and also in the German section. The American chairs have an innovation in the replacing the ball and socket-joints by suitable mechanism. They allow of all imaginable positions, and can be handled very easily and with little exertion.

Filling material.—S. White's preparation, "the globe gold-foil," is entirely new.

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MILITARY CARTOGRAPHY.

(Group XIV, Section 6, and Group XVII, Section 4.)

REPORT BY JOSEPH ZAFFAUK.

343. In the first place we find here the Geographical Society of New York, which exhibited its maps in a very unsatisfactory position. They were mostly nautical maps of different proportions, (1: 80,000; 1: 40,000; 1: 20,000, &c.,) and also varying greatly in external size, some of them being several feet long. They are all handsome copper-prints, and fulfill all the requirements of good nautical maps.

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GROUP XV.

MUSICAL INSTRUMENTS.

Report by Eduard Schelle.

HARMONIUMS.

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344. The Americans also lay claim to the honor of having first built organs in which the notes are produced by metal tongues. Aaron Merril Peaseley is named as the earliest inventor; he received a patent, as distinction, from the Government of the United States in 1818. At all events, the physharmonium is really the origin of the brilliant-toned and musical harmoniums which decorated the Austrian and German sections, and it forms as strong a contrast with the latter as the mallet-cymbal of Christofali, of the last century, forms with the modern apparatus with the English mechanism and crossed strings.

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345. The harmoniums exhibited by the firm of Mason & Hamlin, in the American section, were among the most deserving and meritorious instruments. In consequence of the application of suction-bellows instead of force-bellows, these instruments have quite a different character from those of European makers. Another peculiarity is that each tongue has its separate cell. By means of a spring the cell is opened when the key is struck, and is again closed on the release of the key. By means of these central pressure-valves the precision in the action of this instrument is made to equal that of the piano. The tongues are fine, well formed, and carefully executed. By means of this arrangement an organ-like tone has been produced, which distinguishes the American instruments so completely from the European. In order to produce as full a tone as possible, a corresponding increase, in size, of the resonator has been made, and the patent of this resonator is the property of the firm. One of the many advantages of these instruments is a contrivance for the crescendo register, by means of which the effect of the pedal becomes less marked than with the register employed in our country.

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GROUP XVI.

Section 2.—General military equipments.

Report by Gustav Semrad and Johann Sterbenz.

ARTILLERY.

346. E. Remington exhibited rifles in a truly sumptuous manner, selecting styles similar to those adopted for the American Army and Navy, and the Danish, Swedish, Spanish, and Egyptian models. He thus showed the great extent to which his rifles are employed as weapons of war.

Besides the well-known systems of Peabody, Colt, and Bérdan, in the American section, there were: Springfield rifles with a kind of Wänzl apparatus for closing, all the various states of the production of the parts of rifles; improved Sharps rifles and carbines with breech-blocks, in which the vertical motion of the latter is accomplished by moving trigger-guard; Ward-Burton's self-cocker with a closing apparatus, which can be fixed by the aid of a screw; finally, Laidley's rifles, a modification of Remington's system, and which had also been exhibited at the last Paris Exhibition.

The metal cartridges of the Union Cartridge Company showed the great perfection which this branch of industry has attained in America.

If, however, we draw our conclusion as to the American exhibition of weapons of war, we find it to be the same as with most other states, namely, the manufacture has attained the limit of technical and military perfection, but the exhibits are all well known. Even the repeating-weapons, which had become very popular during the late rebellion, showed no progress at the Exhibition.

It seems to be in place here to mention a gun, belonging to the latter class of weapons, which was brought to Vienna by Captain Meigs during the Exhibition, although not as an exhibit, and was here submitted to several trials. This weapon belongs to that class of repeaters whose magazine is contained in the stock. The latter, by its peculiar construction, was able to receive an iron cylinder with fifty cartridges. The cartridges are transferred to the barrel by means of a simple mechanism. We are not permitted to give a more detailed description; we will, however, state that the inventor repeatedly discharged all the cartridges in the weapon in from twenty-two to twenty-five seconds, in presence of a commission of professional men. The cartridges are loaded, fired off, and thrown out by one motion of the trigger-guard.

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There is a sound idea underlying the repeating mechanism, and Captain Meigs could undoubtedly make his gun, which is at present in its infancy, a useful but also a terrible weapon if he would associate himself with an experienced gun-manufacturer.

Section 3.—Military sanitary apparatus and voluntary aid during war.

Report by Dr. M. von Moorhof.

HOSPITAL RAILROAD-CARS.

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347. America was the first to teach us that cars for the transport of the wounded should be especially arranged with a view to making them suitable for such requirements.

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As mentioned above, to America belongs the merit of having first shown, in the late rebellion, that existing materials must be employed for transportation of the wounded on a large scale, and how to do it This it accomplished through Dr. Harris, of New York, a member of the sanitary commission.

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We must here state that the windows of the passenger-cars are not a sufficient means of ventilation, and other arrangements better suited to the purpose have become necessary. Of this we may also take America as an example. In America all passenger-cars have ventilators at the roof, with small windows opening sideways, beside the windows which are necessary for light and the view, thus enabling a fresh supply of air from above and an easy exit of the warm and bad air which accumulates at the ceiling. The passenger-cars in America are, therefore, ventilated according to the physical laws which should regulate all ventilation. The entrance of coal-dust is prevented by fine-wire gauze or ventilation-blinds, or by allowing the air to pass through water before it enters the car. Ventilation by means of lanterns at the roof is very desirable for the common purposes of life, and should certainly be introduced in all new passenger-cars.

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Section 3.—Engineer and pioneer matters.

Report by Moriz Brunner, Johann Lauer, and Emerich Zinner.

VARIOUS OBJECTS.

348. Among the many hand-tools exhibited in the departments of England and North America, we wish to draw special attention to the shovels. It is really remarkable that we find the forms of this species of tools to be the same, not merely in these two important countries, which have always been and will probably remainthe leaders in advancing technology, but also in other states, and therefore in the majority of them, while, at the same time, they are totally different from those used with us. The blade of the shovel is not bent lengthwise, but straight, but it is somewhat hollow across; it is large, and, what is more remarkable, it is formed rectangularly, and only the sharp corners are rounded off a little. The handle is short and somewhat bent and has either a crutch or a well-formed oval handle at the upper end. It would seem to be worth the while to take this tool of the practical English and Americans in hand and to test its value.

GROUP XVII.

SECTIONS 1 TO 4.—NAVAL APPLIANCES.

REPORT BY ALEXANDER FRIEDMANN, C. E. NAVAL STRUCTURES AND PORTS, NEW YORK.

349. We will begin with the blasting at Hallet's Point, near New York, which was exhibited *en modelle*. Special interest is attached to this, as well on account of its being the largest and grandest piece of blasting which has ever been undertaken below the water, as on account of the special interest for Austrians which attaches to it, since we also must blast rocks on the Danube, near the Eisernes Thor, which, although smaller and more easily removed, are a greater obstacle to our navigation than the rocks at Hallet's Point prove to the port of New York.

The entrance to New York is obstructed by a reef extending from Hallett's Point, Long Island, more than 200 feet out into the passage at Hell Gate. The depth of the reef below the mean low-water level is only 12 feet at a distance of 270 feet from the shore. The idea is to obtain a depth of from 25 to 26 feet. The work extends, therefore, over an area of 14,000 square yards; 50,584 cubic yards of rock must be removed. The plans were originated by John Newton, colonel of engineers, the novel principle being to remove the rock, not piecemeal, by drilling a number of separate holes and blasting them, but to undermine the whole mass of rocks of an area of 14,000 square yards, at a depth of 33 feet, by means of shafts carried below it, in such a manner that the whole mass of rocks finally rests upon only a few pillars. The shafts are then to receive a sufficient quantity of blasting material, and the whole immense charge is to be ignited at once, thus blasting away the 50,000 cubic yards at once. In order to be able to carry these galleries or shafts at a depth of 33 feet below the mean low-water level, a main shaft was sunk in the same manner as when a large mine is to be opened; from this main shaft the large galleries radiate, and concentric galleries then are cut through the intermediate walls in such a manner that none of the galleries open into the sea, whereby the whole work would be put under water. In order to be able to cut the main shaft, a coffer-dam was built between the mean high-water level and the mean low-water level, and the whole space which it included was laid dry. Thereupon the shaft was sunk to a depth of 33 feet, and of a large diameter, and the galleries were cut; about 90 safety-pillars remaining, whose thickness and number will, however, be diminished considerably before blasting. The two main tunnels, running nearest to the shore to the right and to the left, are almost finished to the required length, as well as the main tunnel running under the outside point of the coffer-dam and under the ridge of the rocks in almost their entire length. Mr. Newton writes as follows: The bottom of the shaft is about 33 feet

below the mean low-water level. The floor of the galleries generally follows the inclination of the surface of the rocks. The works are drained by means of water-pipes running radially to the end of the tunnels, and exhausted by means of two pumps, each of which has a capacity of 100 gallons. These pumps were not yet worked up to their full capacity. The reef consists of hard gneiss in almost vertical layers, and runs in a northeastern direction. The holes are drilled by Burleigh's percussion-machine; diamond drills and hand-drills were also employed. Compressed air is used for the drills; the holes have a depth of from 3 to 4 feet; their charges consist of one-half pound of nitro-glycerine for each hole. These small charges have been used on account of the danger, incident to large charges, of shaking the tunnel and the galleries too strongly, and they also explain the slow progress made in comparison with tunnel-work on dry land. Until now not a single accident has happened during the preparation of and blasting with 20,000 charges of nitro-glycerine.

The coffer-dam was begun in July, 1869, and the driving of the main shaft in October of the same year. The total length of tunnels, shafts, and galleries, finished up to February 1, 1872, was 4,716 feet. The inspection of the total surface, under which the rocks are to be removed, is almost completed.

In order to make Hell Gate navigable by ships of greater draught, it is necessary to remove another reef, called Flood Rock, whereby the present width of the passage, 600 feet, will be doubled. The plan which has been used for Hell Gate will also be adopted for this rock. The smaller reefs lying in the valley, have been partly removed in other manners. A machine built for the purpose, drills holes into the rocks from the surface of the water.

This work is performed for the city of New York. New York is an important city, and although the entrance to its port would be safe under all circumstances, this assistance of the entrance is a laudable and suitable undertaking.

The blasting of the rocks before and at the "Eisernes Thor," which almost cut off the Danube of the whole Austrian district from its lower course and the Black Sea during the greater part of the shipping-time, would be a much easier and much more important piece of work.

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GROUP XXV.

FINE ARTS OF THE PRESENT DAY.

Report by Josef Bayer and Josef Langl.

PAINTING.

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350. From North America there were about a dozen paintings at the Exhibition. Mr. Waterman, of the State of Rhode Island, had made a large painting of "Gulliver in Lilliput." This is a subject which is better suited for water-color painting than oil-painting, like all fantastic subjects of this kind. The most remarkable examples of American art that were exhibited in the Art Hall were probably the landscape pictures by Albert Bierstadt, of New York, in the central hall; the Emerald Lake in the White Mountains of New Hampshire, and another large landscape from America. These paintings are imposing by their grand scenery and an extensive scope of conception in the landscapes, in spite of a certain even decorative appearance.

GROUP XXVI.

Sections 2 and 3.—Plans, arrangements, and means of instruction of public and intermediate schools.

Report by Erasmus Schwab, Dr. R. Perkmann, Dr. Pokorny, and Professor Knirr.

THE AMERICAN SCHOOL-HOUSE.

351. The American country school-house was exhibited near the western entrance of the Exhibition building in a very favorable situation. It was a one-story frame-house, painted gray, and roofed with felt. The structure, however, was not properly a school-house, but only a single school-room, the large dimensions of which made a very favorable impression on the European visitors, who are not accustomed to such proportions.

The house had separate entrances, on opposite sides, for the boys and the girls, with small halls for taking off the walking garments, although there were no wardrobes proper. The walls of the room were wainscoted several feet high, the upper part being papered.

The uncommonly high and airy room received its light through six narrow, high windows, two pretty far apart, in the rear wall, and two in each side wall. These windows were single, sliding windows, as in most American schools, without any turning sashes. Double windows for the winter were wanting. The blinds, which could be moved, opened, and rolled up in any direction, were most efficient regulators for the light, and were valuable especially for drawing-exercises. They can be made of any cheap material, but it must not be forgotten that this ingenious arrangement becomes expensive, requiring many screws, rollers, &c. Moreover, it must be observed that the light coming from three sides causes a faulty illumination, which is only excusable where the effects of a foggy climate have to be overcome. The size of the class-room does not demand it. The room was ventilated in the usual way, by ventilators in opposite walls. Besides these, the windows had several small apparatus of sheet-iron attached to them, with small holes in some parts, like a sieve, and one of them having a stop-cock attached to it. This apparatus is also for sale in our country, but I cannot judge of their use and value for school purposes. Nothing new was observable, either in this direction or in the arrangement for heating the room, which was merely indicated by the painting. From among the different methods in use for this purpose, hot-air heating had been selected, although this is not by any means the best. It has been introduced in many German schools, and is a just cause of bitter complaint by many teachers.

The most captivating objects, to the visitors, were the desks and seats. The enormous space of the school-room contained only eight

seats, for single scholars, in each of the five rows, allowing seats for only forty pupils; which number certainly forms an ideal maximum for teachers.

One piece of furniture, common to European schools, was not to be found at all; the chest for materials of instruction. A substitute for it was formed by a small space in the wall behind the seat of the teacher, closed by a door, being merely for the use of the teacher. The want of such a chest is explained by the circumstance that Americans have no idea of using objects for instruction in the schools, nor of the necessity of small class-museums. Nor was there a black-board in the room; there being, instead, a black screen of canvass, behind the pupils, on which one could write with chalk. On the other hand, there was in the school-room a small box with grooves to receive the slates of the children, which arrangement saves them the trouble of carrying their slates home. A similar arrangement was to be seen in many of the European departments, the Swedes skillfully using the desk itself for that purpose. The desk for the teacher was finished in such a luxurious style, that it would be folly to think of recommending furniture of that kind for use in schools on the European continent.

One thing, in the midst of these barren surroundings, made a very favorable impression; a very elegant harmonium was standing near the desk of the teacher; curiously, however, the instructor turned his back to the pupils.

The seats for the teacher were quite convenient. The other furniture of the school-room consisted of a not very beautiful, common stand for the note-board, a table with divisible geometrical bodies,* another table with photographs of school-houses and writing copies, and a very large globe on a stand. The material for instruction consisted of charts hanging at the wall—nothing else!

Stress was laid upon instruction in geography. Very large maps, which were not faultless by the way, represented not only America, but all other parts of the world, in single sheets. To the eye of the teacher it was clear that this extensive scheme could not be accomplished in any European country school, not even superficially, and that if a commercial nation has its reasons for allotting to instruction in geography such an undue share of time, other practical knowledge must be dropped.

In fact, for natural history there were only a few plates adapted to the purpose, containing but one typical representation on a larger scale, surrounded by other specimens of the same character on a smaller scale; but most of the plates were worthless on account of the amount of material which they contained, as well as the small size of the figures, and no European school would admit them.

Collections for natural history, instruments for instruction in natural philosophy, objects explaining and illustrating the readers, and a small library for the people, the teacher, or the scholars, were entirely wanting.

* This contrivance must certainly be called very ingenious.

Instead of all this, there were only the outlines of the political relations of the States of the great republic. The means of instruction were represented by apparatus for reading and ciphering, drawing-copies, slates, the margins of which contained movable copies for writing, ciphering, and elementary drawing, and finally a number of books.

The school-house comprised, besides the school-room and the two small entrance-halls, only one other room for the use of the commission of the Exhibition, which was, perhaps, meant to be the office of the teacher. The school-house did not contain lodging-rooms for the teacher, and, in this direction, the curiosity of a good many Europeans remained unsatisfied. In the cities teachers are not permitted to live in the school-house; the janitor only has his residence in the basement. It must be admitted that the air in the school-house is kept purer in this way. We regretted the absence of an arrangement for privies, from which we Europeans might have derived some good ideas.

After repeated visits paid to the American country school-house nobody could but admit that in regard to space handsome provisions were made in the pavilion, which was called a school-house, and also in regard to the required air. The arrangement of the windows cannot be recommended for imitation in Europe. A closer investigation into the matter, however, convinced us that halls for instruction of such colossal dimensions could scarcely, or rather not at all, be procured in European schools; but perhaps they are altogether unnecessary if plenty of fresh air is provided for. Further, we came to the conclusion that the exhibitors had not proposed to show how the sanitary requirements are, in reality, complied with in American schools, or how the question on this subject can be solved in the best manner. The arrangements for overcoming the bad effects of dust in the school-room were simply imaginary, or rather puerile.

The much-admired desks will be spoken of in the article describing school furniture.

From the "American country school-house" the visitor could not form a true conception of how school-houses are built and arranged in North America; nor could he judge what school-houses in general looked like in that country. Not even the smallest community in Europe could use a school-house built after the model exhibited.

The provision made for instruction was in many respects inadequate; for many things which have been used for a long time in Europe are yet unknown in America. On the other hand, at least some of the few means of instruction justified the question whether it had been thought worth while to represent to the Europeans a true picture of the pedagogic apparatus used in the American country school-house.*

* Among the wall-maps was a map of the Roman empire. An occurrence of this kind would find an easy explanation, if it were true as was rumored, that an American book-seller, who could not find room for his exhibits in the main building, was permitted to exhibit his maps in—the "country school-house."

We could not avoid the distressing impression made upon us that the American schools have many defects which must be remedied if the young generation of America shall equal in all respects the generation of the European countries which is educated in schools similar to those which were exhibited by the German nations. In schools built and arranged like the one exhibited, a generation may grow up, which is bodily healthy and has common sense, although without much learning, but never a generation with ideals; good taste, sense of beauty, and the poetry of the life of children find no room in such a school. An education of the pupil, in which all the faculties of man are equally developed, is out of the question. That the highly-gifted American nation retains in its schools many things which, even in Austria, not to speak of Germany, have long since been abolished; that it lacks many institutions which have been established for a long period of time, according to the refined ideals of European instructors and patrons of schools—for instance, the female working-school, so important an institution in social and moral respects; all these, and other deficiencies, are caused by the circumstance that America, as yet, lacks a distinctly established class of teachers in the social scale. As a rule, the occupation of teaching is there taken up and continued only until a more lucrative situation can be found.

Calculating alone cannot institute a school, even if it be connected with or assisted by a patriotic spirit, of which North America has produced immortal examples. One of the essential conditions for this purpose, and the principal one, is that the teacher shall embrace his vocation with a heartfelt cherishing love, as something sacred, which he, however, cannot take up without a thorough education, agreeing with the requirements of the age; in which he cannot stand still, but must always learn, and which he cannot give up for any consideration of money or commodity. As long as America does not create such a class of teachers, whose minds are thoroughly imbued with a sense of their duty, who are full of the true spirit of a teacher, and educated in a correct manner, so long may it continue to contribute in a praiseworthy manner to the development of the sanitary department in school; it may initiate further reforms, owing to its ample means, its common sense and practical skill in specialties belonging to school matters, and may produce ingenious contrivances which deserve to be imitated; but, on the whole, it never will attain to the high position of the pioneers in the domain of instruction and education of the people, if the educators of North America do not soon make a reform movement.

The "American country-school-house" will serve to reduce to their proper limits those exaggerated ideas which, originated by extravagant pictures drawn by European writers, have lately taken possession of many heads in Europe. North America, on the other hand, with its gigantic energy, will, as we hope and wish, continue the great work commenced by the Germanic nations.

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PLANS OF SCHOOL-HOUSES.

352. City school-houses of North America were illustrated, not only by a large number of plans, but also by the very instructive model of the Franklin school-house in Washington, a city where the temperature varies through a range of 45°. The rooms were heated by low-pressure steam; for ventilation, fans are used. Both have proved satisfactory for a number of years. They cannot, however, be well explained without illustrations. Each room has an area of 900 square feet (89.9 square meters) by 15 feet (4.7 meters) in height. It is to be regretted that the number of scholars to each room was not given. The American schools have near them large play-grounds, but they lack a school garden, which, however, cannot be procured as long as there is no distinct body of teachers, who follow their freely-chosen vocation with heart and soul. The basement contains rooms for recreation during recess, being used in bad weather. In winter they are heated; in summer they are agreeably cool. The Americans also ventilate these rooms thoroughly, in compliance with the injunctions of their sanitary leader, Lewis Leeds, who was wont to say "exhaled air is the worst enemy of man." The privies, or excellent water-closets, are not in the school-houses at the new city schools, as is usual in Europe, but are in the yard, and are connected with the school-house by covered walks. In those cases in which they are within the school-house, they are carefully secluded, well ventilated, and, what must not be overlooked, they are all in the basement.

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APPARATUS.

353. The American seat was noticeable. This seat was placed on an iron base, on which it could be folded; it was made of beautiful broad, polished laths, which, in order to prevent over-heating, did not fit closely together. The table top is movable forward, and covers a small recess for books. The arrangement was of a compact form, having a seat for one row of boys backed by a desk for the next row, and thus the support of the desk in the rear served as a back for the seat in front. These backs were rounded, slanting backward, and comfortable. They could be folded up entirely, and they captivated the visitors; pretty stout gentlemen and ladies in dresses of a considerable circumference were comfortably seated in them, as they were made for grown people.

We could not judge how many different sizes would be necessary for the different ages of children. The price for such a desk for a single person was at first stated at 20 florins, (13 thaler 3 groshen,) afterward at 16 florins, (10 thaler 15 groshen.) In Europe, according to the statements of professional men, such seats would be too costly. Besides these much-admired seats, smaller ones for children were exhibited, the desks, in proper position for writing, with immovable seats, whose back furnished very comfortable supports for back and arms.

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SPECIAL REPORT ON GROUP XXVI.

MEANS OF INSTRUCTION IN NATURAL HISTORY.

Report by Dr. A. Pokorny.

354. The United States exhibited, among their means of instruction, as well as in their school-houses, remarkable specimens of pictures for teaching natural history, partly in book-form, partly in the form of plates. Among the latter, Prang's Natural History Serics, for the use of school and home, deserves special mention. These very tasteful plates, consisting of several small pictures surrounding a larger one, form groups of kindred natural objects. Thus, for instance, different forms of leaves surrounding one larger leaf in the midst of the plate. In the same way a lily, a pink, &c., are surrounded by plants of the same order, or a cat, a heron, or a cow, by animals of their respective families. The single pictures being very elegant and splendidly colored, the whole makes a very good impression, and can be seen distinctly even at a great distance, much better than pictures which, as is usually the case, contain a whole group on the same sheet. There were plates composed for the different grades of instruction, for primary, grammar, and high schools.

Wilson & Calkin's (of New York) school and house plates for natural history contain similar groups of small pictures, which, however, are accompanied by detailed descriptions. They consist partly of characteristic pictures of animals and plants, partly of morphological and terminological representations.

Cuttler, of Philadelphia, has published plates illustrating anatomy and anthropology, from among which especially those representing the same organic system through the different orders of vertebrata are useful for instruction.

Section 6.—Education in the broadest sense.

STATISTICS AND GENERAL MEANS OF INSTRUCTION.

Report by J. Löwenthal.

355. It is unfortunate that the special catalogue, published as a guide in the very interesting galleries of the North American Union, was limited to a mere enumeration of names without statistical remarks like most of the other registers. Group XXVI is very rich in such information, but they generally refer to former periods. One of the newest is the extensive statistical work: The Statistics of the Population of the United States. There were 38,115,641 inhabitants in 1870, exclusive of the Indian tribes. The population has, therefore, increased by 6,931,897, or 22.22 per cent. within the last decade.

As is well known, the system of compulsory education is carried out with greater strictness in the United States than anywhere else. With good sense, it has been the custom there to take, as a foundation, the principle that only the school can give the necessary general education to a nation. It is probably due to this tendency that the number of schools and scholars, as well as of teachers, bears a proportion to the number of inhabitants which cannot be found in any other country. In 1870, there existed in the United States no less than 14,629 schools of every kind, with 221,042 teachers and 7,209,938 scholars, of which 6,228,060 visit the public schools, and 981,878 attend private schools.

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The proportion of pupils to the number of inhabitants can scarcely be more encouraging in any other country than in the North American Republic. We can, however, not deny them the credit of paying the greatest attention to instruction as the foundation of all education, and that they do everything that can by any possibility assist in its advancement and elevation. A mere promenade through the space allotted to education in the American section was sufficient to produce a realization of the great attention paid to the capacity and talents of the pupils of all ages. There we also found those numerous contrivances and materials for assisting instruction in the most practical manner. How pleasant was the impression which was made upon us by the high and airy rooms of the school-house erected opposite to the exhibition building, with its charts, drawings of all kinds, for illustrating the various objects of instruction; with its harmonium, its reading-books, and its apparatus! The child cannot help asking about one or the other of the representations, one or the other of the models, and he obtains information of some kind from the answer. It is true that some toys enter here, but the child learns in his play. In the exhibition building a stereoscope gives us a vivid idea of the interior of several schools. The most agreeable surprise was occasioned by a view of a large assembling-room with many hundreds of attentive male and female scholars, or the view of one class or the other, in which the pupils listen to the explanations of the male or female teachers with the strictest attention. Instruction and education also formed the subject of the greater proportion of the books and other means of instruction piled up there. All grades were represented, from the primary school up to the college for savants. The high value attributed to these means of instruction was manifested by the slate, the largest globes, the representations for natural history, as well as the numerous reports of the school authorities. Not a State, not a city had been omitted, and a complete literature of books of instruction was to be found; and these many societies and publishing-houses deserve real credit for the pains which they have taken.

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Among other standard works we will mention Ellwood T. Zell's excellent and beautifully bound "Popular Encyclopedia," and the Smithsonian "Contributions to Knowledge." The "American Journal of

Education," from Boston, for 1856–1871, and "Chambers's Encyclopedia," and the "New American Encyclopedia," are no less worthy of remark. We do not wish to say that all the above-mentioned works are of equal importance; some of them even seemed to be of ordinary value; but it shows how general is this acknowledgment of the value of means of instruction.

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GENERAL MEANS OF INSTRUCTION.

Report by Rudolf Lechner, Alfred Klar and Dr. Carl Th. Richter.

THE BOOK-TRADE AND LITERATURE OF FOREIGN COUNTRIES.

356. A side glance at the English literature of America revealed the interesting phenomenon that a poetical, fantastic, and sometimes somewhat religious tendency is observable, in the midst of the sensational daily literature, and the dry, practical publications. A national American illustration of this tendency is found in the seven songs by which Joaquin Miller, the singer of the New World, whose fame rose so rapidly, in fantastical garb celebrates his adventures in the land of the gold-diggers. Longfellow's "Divine Tragedy" is also remarkable, as a strictly religious poem, in the manner of the ancient miracle play; it cannot, however, be given a place beside the renowned poems of this American poet, on account of its artificial enthusiasm.

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However little the exhibition of books by the United States was calculated to give even a faint idea of the literary activity and state of the book-trade on the other side of the Atlantic, the small and even fragmentary exhibits gave a really astonishing idea of the activity which is developed by the Government of the greatest of all republics in assisting mental labor. Frequently we hear cool praise, or even a condemnation of American sedateness; frequently theoretical savants, poets, and artists believe they must turn their backs to a form of government under which dominating practical good sense seems to reject every absolutely idealistic tendency. Nevertheless it needs no more than an earnest examination into the whole literary work of North America to recognize that the material gain for which Americans work individually is also offered to mental labor and in an imposing manner. A tendency is evinced, in the assistance given to schools and other really scientific directions, in a manner which surpasses even the royal munificence, to replace the historical development of literature by extensive, widely-spread, and richly-endowed institutions, in the modern spirit.

The exhibition did not give an adequate idea of the immense wealth of books which has developed the industrial part of the book-trade to such a high degree, far surpassing the Old World in quantity of production.

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An insight into this excellent organization, and the extensive activity of the literary world, was furnished by the American Social Science Association, a society of savants and philanthropists, who attempt so-

cial progress theoretically, and practically assist the schools, and have investigations made in law, in reforms, in the penal system, and in sanitary questions, at a great expense of money and labor. In a similar manner philanthropy is manifested in the Astor library of New York, which immediately follows the library of the Congress of the United States as the most important and largest library of the country. It contains 200,000 volumes, and embraces all doctrines and branches of literature. It was founded by John Jacob Astor, who endowed it with 2,000,000 francs, ($400,000.) His son continued this charity by giving the library, which is free to all, a number of buildings. The Lowell Institute at Boston, named after its founder, works in a different manner for the gratuitous distribution of education throughout the widest circles. It provides lectures on scientific and literary subjects by the most prominent men of the United States. Four hundred and sixty-four lectures were delivered in 1872.

357. The National Bureau of Education at Washington gives a truly surprising illustration of the patriotic feeling, and the earnest and general inclination to have a capable, educated people. We will only mention, by the way, that the participation of America in the Universal Exhibition was mainly a consequence of the activity of this Bureau, which did not merely originate the idea, but hesitated at no expense to realize the idea. The same Bureau has influenced Congress to devote the money realized from the sale of large tracts of country to the purposes of education. The Bureau also acts as a publisher, by the publication of a colossal work, comprising the complete statistical reports relating to education in general in the United States. This work gives an influence over the whole immense system of schools, and is of great value as an agent for all progress. Congress has granted $40,000 annually for this purpose.

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MEANS OF INSTRUCTION IN SOCIAL ECONONY.

Report by Dr. Carl Th. Richter.

PUBLIC LIBRARIES.

358. We will follow the States in their order, as they follow each other in the Industrial Palace. America brought some of the catalogues of its numerous libraries, belonging either to particular societies or to the community at large. To the former class belong the so-called Mechanics' and Mercantile Library Associations, of which the societies at New York, at Boston, and Brockfield exhibited their catalogues, and which mostly contain works by English and American authors, and principally those of technical interest. Among the latter class were the public libraries at Washington, Weston, Winchester, Worcester, and the library of the Young Men's Christian Association of New York, which also sent catalogues and particular works to the exhibition. These libraries are best characterized by the fact that they are everywhere recognized as public and are open to all.

GROUP XXVI.

MEANS OF INSTRUCTION IN MUSIC.

Report by Rudolf Weinwurm.

359. The American school-house, one of the objects of the Universal Exhibition, as well as several others that appeared in Group XXVI in the palace of the Universal Exhibition, gave token of the acceptable fact that special attention is beginning to be paid to instruction in singing in the American schools. In accordance with this fact there is a special superintendent, or supervisor of music, among the school authorities, whose duty it is to supervise musical instruction in the public schools. The general catalogue contained a special remark appended to the notice of the American school-house: "furnished as is usual in the rural districts of America." We must congratulate the country which does not hesitate at the expense of furnishing its school-houses, with regard to this matter, not merely with some of the song-books mentioned below and a few musical charts, but also adds an instrument to accompany the singing, like the one we found. It is a very good harmonium (school-organ) from the Mason & Hamlin Organ Company of Boston, which, we are told, has made a specialty of furnishing such instruments for schools. For this purpose it furnishes four octave instruments at the price of 85 florins, ($35,) a very liberal price for America, although it cannot compare with the prices mentioned for Sweden. The instrument contained in the school-houses is not one of these cheap ones; it is one of five octaves, two registers, and a sweller, and the price would be about 250 gulden, ($100,) according to reliable testimony. The richer schools, as well as the seminaries, usually employ these instruments for accompaniment, and when it is necessary they are even qualified for independent production, at least for the rudiments of instruction. Pianos and harmoniums (church-organs) are also employed for instruction in the seminaries. The great advantages of these instruments, even the cheapest, even the violin, which is employed for general instruction in singing in almost all other States, are perfectly evident. Persons of opposite opinion may refer to the corresponding paragraph of the official report for the Austrian exhibition of means of instruction.

There was a double interest attached to the exhibit of American means of instruction: in the first instance, on its own account as illustrating the method of instruction; and furthermore, as indicating the influence of other countries, which were brought to bear in a prominent manner, corresponding to the natural conditions. If it is interesting to the German to follow the spread of his popular melodies in European countries —with reference to which several hints have been given in what has preceded—this interest really becomes a matter of heartfelt enjoyment

in a country which owes a great part of its development and culture to German immigation. The German national songs play an important part in the song-books exhibited, and not only in the collections for two languages, as Reffelt's "Deutsch-Englisches Liederbuch," Steiger, New York, but also in the purely English song-books for one or two voices. Everywhere we meet dear old acquaintances, the companions and friends of our youth, and we greet them as such, although they sometimes are clothed in a strange garb, even sometimes wish to deny their origin; and the long voyage has often not been without deleterious influence upon their originally sound constitution. Germany generally has to furnish the practical part of the instruction in singing, with few exceptions, and the young American, for instance, enjoys hearing, in the same melodies as the German boy, that winter has removed; that May has arrived; that the cuckoo calls; that the Christmas-tree remains green in winter; that bells tinkle; he warns the fox that has stolen the goose; he calls to the reel, &c. This enumeration would be greatly extended if we were to consider the collections of songs for three and four voices, which also resemble some of the German collections, by the absence of artistic spirit and arrangement.

Taking it as a whole, the method of elementary instruction is satisfactory. The musical charts found in the American school-house are composed by Mason & Sharland of Boston, and follow about the same plan as those of Schäubling (*vide* Switzerland) or the well-known charts of Silber. Beside these charts there is generally a song-book, which is employed in later years. Several of these song-books contain a short method of instruction for the teacher, so that they can also be employed in the teachers' institutes. The above-mentioned Swiss method (starting from one line) is also represented in a work by Loomis, "First Steps in Music," New York and Chicago. Mason's means of musical instruction are said to have the widest application, and several of them were represented. There was also exhibited a collection of solos, duets, trios, and quartettes, of the best masters, under the title of "The Cantata," published by Nash & Bristow of New York, and several collections of religious songs, hymns, and choral books. Other divisions of musical instruction were not represented. Although that which was represented allowed of many additional improvements it, nevertheless, gives rise to the hope that the United States will be soon able to exhibit great improvements in this branch.

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Section 6.—Means of instruction in general.

Report by Rudolf Lechner, Alfred Klar, and Dr. Carl Th. Richter.

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360. Among the great publishing firms, that of Harper & Brothers of New York, employing 600 men, and selling annually more than 2,000,000 books, and Lippincott & Co., of Philadelphia, the largest publishing

firm of the world, were represented. The firm of Appleton & Co. of New York also stood well with its great topographical work of North America.

A better understanding of the immense production of literary work in the United States was afforded by the exhibition of journals, of which Mr. E. Steiger, the bookseller, exhibited more than five thousand different sets which he had collected and classified in folios; also the exhibition of means of instruction with its great number of text-books for all schools, and finally the exhibition of the public libraries, no less than fifty-five of which exhibited their catalogues. The library of Congress and the Astor library can well bear comparison with the best libraries of the world as regards the number, selection, and arrangement of the books. The libraries of the workingmen's societies (at Worcester and Lowell) are a specialty which may serve as models in the variety and the practical selection of contents.

The first place among the educational journals of the United States is occupied by that of Dr. Henry Barnard, published at Hartford for twenty-five years. This journal is sustained at a great expense, and contains valuable information relating to education by the most prominent men of the United States.

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Instruction in drawing and the fine arts.

Partial report on Group XXVI, by J. Langl.

361. One of our most renowned German professors of art made the significant remark after the Universal Exhibition in London, 1851, that an organization for instruction in the fine arts, in accordance with the principles on which a plan was proposed by the English, at that time, could be more easily carried out and would work with greater effect in a country which has no old traditions to battle with, and which enjoys the most liberal institutions, in the United States of North America. This remark contains a good deal of truth; it is, however, a question whether, all conditions being taken into account, an undertaking of this kind at the present time would give any satisfaction. As long as America is not quite developed, as long as its turn is exclusively materialistic, and all energy and strength are absorbed by this, no ideals can germinate and grow. Opposite endeavors are only the continuation of European traditions, which, however, have a tendency rather to be stunted or to degenerate than to flourish in a foreign climate. All that America produces in art, especially in sculpture, is of European origin; its industry has a bent inclining more toward the practical than artistic; a national taste cannot be observed as yet. The capitals of Europe will have to continue to provide America with articles of luxury.

An independent character might, perhaps, if in anything, be developed in architecture; but even that shows, as yet, nothing but European ideas, which are often used in most extravagant compositions, ornaments

executed in a pompous style, in consequence of greater means. Photographs from Chicago, Cincinnati, and Philadelphia furnished characteristic examples of this.

Only by well-organized museums and well-directed instruction in the fine arts in schools can taste be developed. In both respects America has only taken its first step. Speaking of the school, we must admit that its significance and value are acknowledged everywhere in America, and instruction is assisted by the greatest liberality.

The American school-house at the Exhibition was greatly praised by professional men. The material used for instruction in the United States may be called excellent, but this does not cover everything. The primary condition of success in school is always an able instructor, and such are pretty scarce in America. On the other hand, a uniform system as regards the classification of schools is lacking; every State, even the single cities, make separate arrangements, which certainly have a tendency to prevent a sound development of education in general. It is, therefore, easy to comprehend why high schools, in the European sense of the term, do not yet exist in America.

In spite of these unfavorable auspices, the introduction of drawing into the schools has been urged by a great many with the same views as recently in Europe. In the prominent cities drawing is taught in schools, and some of the results were shown in the Exhibition. Owing to the circumstances just mentioned, these specimens could not be of much account, even if the best originals and the best methods had been available; but the latter is, in many respects, deficient. Thus, in many schools in which drawing is taught, the teacher, himself, not having sufficient knowledge of his object, employs, generally, Berlin drawing-books, by Hermes, as copies. In some schools in larger cities, drawing-teachers proper are employed; but it is impossible to give a rational instruction if these teachers must instruct in a great number of schools. Thus a report from Toledo, Ohio, tells us that for seventy-four classes one drawing-teacher is employed.

The method of instruction could not be learned from the exhibits. The same must be said of the grammar-schools of the city of New York, in which landscapes, animals, flowers, &c., are copied. In only a few instances were attempts made to draw geometrical forms from nature, which, however, gave little satisfaction, in consequence of the deficient preparatory acquirements of the scholars. Some of the higher schools in New York exhibited framed drawings of vessels, furniture, &c., done by scholars of from twelve to fifteen years of age; also copies of heads, landscapes, and animals, (after Hermes and Julien.) These latter were drawn a little better and made some show as pictures, but they did not illustrate the method of instruction. A number of ornaments (after Bauer) were copied, one resembling the other so much that it was doubtful whether the different names subscribed also meant different persons.

The same may be said about Chicago, only we must mention the great number of maps drawn there, in which the greatest stress seems to be laid upon the colored margins round the oceans.

The regulations for the instruction in drawing in the schools of Chicago merely lay a stress on the importance and value of this branch of study for the different trades and professions, and do not contain a programme for grades in instructing.

By the common schools in Cincinnati, drawings of pupils were exhibited in very showy bindings, the same sketch being executed by a whole class. Thus you would meet with the same object fifty or sixty times. The objects consisted, for the most part, of small geometrical ornaments, star-figures, &c., well executed, and we could, at least, perceive a principle underlying the work. On the other hand, we found anything but good taste in the drawings exhibited by the teachers' normal and high schools.

Judging from what was exhibited, the instruction in drawing is conducted in the best manner in Boston, Mass. "The Drawing-Book of Standard Reproductions and Original designs, for public schools, drawing classes, and schools of art," by Walter Smith, is introduced in most schools. This work recommends itself, especially its first part, for elementary instruction, in which a gradual progress is made from geometrical figures to easy ornaments; in the second part, "Continuation of ornaments," freshness of execution and a defined style in the forms are wanting. After these follows a rather unsystematic series of heads, animals, flowers, even whole human figures, all executed in stiff, cold contours. This system is used in all the public schools, the first exercises being on slates. More advanced scholars also draw from plaster models. Drawings of this kind exhibited showed pretty good results. Solid objects, vessels, vases, &c., are used for that purpose. Picture-drawing is, however, carried on zealously there in female schools, Julien's and Herme's drawing-books being used exclusively.

Some drawing classes exhibited copies (after Smith) showing only moderate progress; the specimens exhibited by the "Free Industrial School" from the State of Massachusetts, however, deserve full praise; among them were found heads (after gypsum models in two crayons) executed very well indeed, besides some very good ornaments.

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PARTIAL REPORT ON GROUP XXVI.

INSTRUCTION IN HISTORY.

REPORT BY DR. EMANUEL HANNAK.

362. In the country of political and religious freedom, in which, during the seventeenth century, equal rights were granted to all sects of Christians, first by Lord Baltimore, in the Catholic settlement of Maryland, the instruction in history certainly meets with more favorable conditions than in countries in which this branch is fettered by a regard for the dominant religion and for crowned heads.

It is, above all, the education of the people, on which, from the days of Washington, a great stress has been laid, the cultivation of which is pointed out as a sacred duty to the American youth, even in the lower classes of the schools. For this reason, the instruction in history in the common schools deserves a careful consideration.* In these, history is principally taught in connection with reading, as is indicated by the school-books exhibited in the American school-house.

Wilson's Fourth Reader contains only sketches from sacred history, as preparatory to a course of instruction in history proper. In the Fifth Reader special attention is paid to ancient history and civilization. The sixth part of Wilson's Reader contains, for instance, essays on Greek and Roman architecture, and one especially treats of the architecture of Athens. In the eleventh part we find episodes from Greek and Roman history, in prose and poetry, and even fragmentary extracts from Aristophanes. This putting of the Greek and Roman histories in the foreground, even in the first stage of instruction, testifies to the sound pedigogical tact of the Americans, and contains a good hint for the authors of school-books for our common schools. In accordance with every acknowledged authority in pedagogy, or following German examples, these books generally treat of all ages in single articles in their readers, thus creating a chaos of ideas in the youthful minds, which, jumbling together ancient conceptions with those of the middle ages and of modern times and conditions, are unable to understand their development in a certain time and distinguish them. The practical Americans follow the maxim *non multa sed multum*, which it would be wise for us to adopt also.

As in the Fifth Reader the ancient history, so in the Sixth, composed

* I must mention here a very significant illustration of the importance which is attributed to education of the people, by quoting the words with which Mr. Wilson, a very successful writer of books for youths, concludes the preface of his American history for primary schools: "As another article in our creed, we should ever regard it as our highest duty to cherish and promote the interest of education, especially as connected with our common schools, knowing that they are 'the people's colleges,' and that, so long as they can be rendered effectual 'nurseries of learning and of virtue,' they will be better guardians of our liberty than fleets and standing armies."

by G. S. Hillard for advanced classes, modern history is placed in the foreground. The reader is arranged with some regard to style; therefore, we find in it, not so much historical narratives as essays referring to some eminent persons, for example, the death and character of Lord Chatham, the character of Washington, a parallel between Canning and Brougham, an essay on John Hampden, and the like. A selection of essays of this kind I could not recommend, from a pedagogical point of view, but it gives token of the practical turn of the American. Every one of them deems it his right and duty to participate in the management of public affairs by word and by deed; therefore, especially the statesmen are pointed out to them, even at an early period of life, who gathered their laurels, not so much on the bloody field of battle, as in Parliament, or who were most noted for something they had achieved for the public welfare. We, too, should begin to follow this direction in the education of our people, to the development of public life here, although it would be a very difficult matter to find characters of that kind in the history of our country.

Another significant hint is contained in the circumstance that the Middle Ages appear to have been omitted altogether from the readers for common schools. In this respect the Americans and Germans differ widely. It certainly must be confessed that in German history that age is exceedingly important, but the conditions and events of the Middle Ages are so involved, that we must ask involuntarily whether our pupils would not be greatly benefited if we gave less time to that period, and extended the space devoted to ancient and modern history. On the same levels stand the primary schools of the cities. For those, other histories exist, which are not compendiums, such as are published in Austria since instruction in history has been introduced, but are more extensive narrations, explained and elucidated by pictures and maps, and are not only instructive, but also entertaining. As a rule, they are special histories, having for their subject the Greek, Roman, and English histories, or they contain the history of the United States, as, for example, Goodrich's Pictorial History of Greece, of Rome, of England, of the United States, or Bonner's Child's History of Greece, two volumes; of Rome, two volumes; of England, two volumes; of the United States, three volumes. Frequently, questions are attached to each chapter, as in Harper's (the publisher's name) "Ancient History for the Use of Schools," by Abbott, and in the English history of the same publisher, or in the little book which we have already mentioned, "Wilson's Primary American History," for primary schools, New York, 1871.

But a book for instruction in universal history is also in existence for this grade. It is Peter Parley's Universal History, New York, 1872. In this book a peculiar method is adopted. The basis for the instruction in history is formed by geography. At first, a complete sketch of the physical and political geography of Asia is given, to which, beginning with sacred history, the history of all the civilized states of that

part of the world is attached. The same method of amalgamizing history and geography was attempted by the Austrian government, in the Instructions for Colleges, published August 13, 1857, and partly carried out by Warhanek, (Zdobinsky,) and Schmied in the books which they composed for that purpose; but this method was soon relinquished as unsuccessful and opposed to sound pedagogical principles.

Whether Markham's History of France is meant to be used for the first grade of instruction in history cannot be learned from the book itself. The fact is that it is not used in the public schools. Perhaps it is in use in private schools paying more attention to the French. We only mention it in this place because in it a dialogue, referring to the contents, (*causerie*,) is attached to each chapter. (The common schools and primary schools are similar to our *volkschulen* and *bürgerschulen*.)

Teachers for those must certainly have a knowledge of universal history, for, although the Teacher's Institute, by William B. Fowle, New York, 1873, contains no special instruction in history, the Elementary and Complete Examiner or Candidate's Assistant, by Isaac Stone, New York, 1873, contains, in its ninth part, questions from universal history, composed after Willard's Universal History. From this we conjecture that candidates have to study this work or similar ones, as Willard's United States History, Berard's History of England, Ricard's History of Rome, and Alison's History of Europe, also Hanna's Biblical History and Marsh's Ecclesiastical History. The last-named book suggests the idea that candidates for the position of teachers there must give particular attention to biblical and ecclesiastical history.

Our *mittel schulen* (intermediate schools) correspond to the grammar schools and colleges, also the high schools. The plans of instruction at the schools in New York and Baltimore show how the subject in history is distributed in different annual courses. In the grammar-school, with eight classes, instruction in history is commenced with the fourth class. In the normal college for females, in New York, which gives six annual courses, history is taught only during the first three years. In the plan of the male college of the city of New York, which has ten classes with five grades, history appears only in the second and third grades. No history is taught in the first grade, or introductory department, and in the two highest grades, junior class and senior class, the place of history is filled by orations. In the two middle grades, history is distributed in such a way that ancient history is taught three lessons a week in the first term in the lower class, and the history of the Middle Ages in the second term; modern history is taught two hours a week in the first and second terms in the class of the second year.

The same books which have been mentioned as intended for the higher grade of the primary school are used as a means of instruction in history for the lower grades in the grammar-schools; in the higher classes of the grammar-schools, very frequently, the Outlines of History, by Wilson, published by Ivison, Blakeman & Taylor, New

York, 1872; this attracts our attention strongly for that reason. The arrangement differs very much from that usual in our books of the same kind. Its first two parts treat exclusively of political history. Occasionally, especially in ancient history, authorities are given. Maps and pictures are distributed in the text. Ancient, English, and American histories are considered at greater length, while Germany is scarcely mentioned at all. The third part is called Outlines of the Philosophy of History, and contains principally a history of civilization. The introduction of this history of civilization is remarkable, and at the same time significant of the liberal mind of the Americans. They are not afraid to put, in place of the Bible stories which form in most of our text-books the beginning of history, the results of modern investigation of prehistoric time, and to begin their history of civilization with a description of the antediluvian world.

I do not approve of a separation of the history of civilization from political history, because both are only intelligible in connection, by their mutual influence on each other. Every impartial person, however, must acknowledge that history ought not to commence with fables relating to a single foreign people, but with the undeniable truths of natural science in regard to the development of the earth and of its inhabitants. The correctness of this assertion is confirmed by one of our own historians, who maintains the same idea in his history of civilization. What he attempted for larger circles should be applied in the school, but certainly not without wise restriction, since the Americans have pointed out the way.

Still another of means for instruction remains to be mentioned: "The Student's Series," published by Harper & Brothers in New York. The titles, "The Student's Gibbon," "The Student's Hume," "Hallam's Middle Ages," by Dr. Smith, "History of the Persian Wars," after Grote, indicate the plan. They are abstracts of acknowledged excellent works on history, and the writer, Dr. Smith, is himself perfectly conversant in ancient, especially in oriental history, as may be judged from his History of the East, in which the most recent investigations on cuneate letters have been made subservient to his purpose. These books may be compared to sketches of character, such as Dr. Pütz, Schoeppner, and others, have composed, in which, also, some fragments from most eminent German historians are found; but they are preferable to the latter on account of their being uniform and continuous works. It would certainly be a very good idea to adopt the American plan, and to make abstracts from Rawlinson's Five Great Monarchies, from Curtin's Greeks, from Theodor Momsen's Roman History, from Giesebrecht's Middle Ages, from Raumer's Hohenstemfen, from Ranke's History of the Reformation, and others, for the use of the scholars of the higher classes of our colleges. Such books would develop a better understanding of history, even in the less talented scholars, for whom the originals are too difficult and too bulky.

Besides these books no other remarkable means of instruction in this line attracted our attention. Even historical maps were not exhibited. The want of these may be excused, inasmuch as the books on history contained maps, plans, and illustrations.

But the preface to the Elements of History, by Worcester, Boston, 1872, gives still another reason. The writer tells us that, with the former editions, he published separate maps in book form. This, however, he did not do with the new edition, because it costs too much.

In general, it cannot be denied that history is taught in the American schools according to the English plan as well in regard to the matter as to the method; but it is the fact that history is taught even in the lowest grade of common and primary schools, and that little importance is ascribed to biblical and ecclesiastical history in common schools, as well as in normal schools. This fact evidently testifies to an independent development of this branch of instruction on the free soil of a free country. The free, and for that reason higher, stand-point of American teachers, also appears in the circumstance that, in colleges, not only ancient and the history of the country is taught, as is done in England, but also universal history.

In this point the Americans agree with the Germans, in attributing great importance to the history of France,* and in arranging their books on history they appear to yield to French influence.

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PENMANSHIP.

Report by J. Hüpscher.

363. *Apparatus.*—The high standard which school matters in general have attained in North America, in so incredibly short a time, is a natural consequence of the liberal care which is bestowed upon them, although we cannot approve of all that has been philanthropically provided for the welfare of youth, part of which is one-sided, part boldly exceeding real wants. In both cases, however, the efforts to accomplish the most possible must be acknowledged. The Americans are said to be ever-calculating business-men, but what they are accomplishing in regard to schools and education, promoted by whatever motives it may be, is gladdening to the heart.

The American school-house is an illustration. The reader, I hope, will excuse me, if I seem to depart from my subject. I do not believe that this will be the case; but then, how the heart and soul of an old schoolmaster become excited when he compares this thoroughly comfortable arrangement with so many of ours, especially in small towns and the country! It is certain that undeniable efforts looking toward improvement have been made, as regards school matters, under an en-

* Besides "Markham's History of France," composed for a lower grade, which we have already mentioned, the "Student's Series" also comprises a "History of France;" history of Germany is nowhere mentioned.

lightened government during late years, but how much remains to be done, before we, government and people, can learn to take the greatest pride in the institution of good schools, even if our motives were not, in the beginning, purely ethic, but more simply mercantile speculations. This not only applies to Austria, but to the whole of Europe, advanced Germany not excepted.

We sacrifice, without hesitation, hundreds of dollars, following the impulse of our unselfish, parental love, if one of our dear children falls sick; but with regard to our schools we are penurious to excess. We should remember that many diseases which often extend their influence far beyond the age of childhood are contracted by our little ones in over-crowded school-rooms, that are not sufficiently well taken care of. If we would only sacrifice for the school and for education the fourth part of what we spend for luxuries easily dispensed with, we could build school-palaces for our children; we could remunerate the best of teachers, not only deservedly, but splendidly. And who would gain most by it? The state as a whole, and we ourselves individually.

The copy-books seen here have, throughout, good half-glazed paper; and some are furnished with copies and lines, some not. A certain care for the requirements of the learner is everywhere perceptible. The use of the gold pen seems to be quite general, if we may be allowed to draw our conclusions from the great number of specimens of penmanship exhibited by male and female scholars of North American schools. Gold pens are hard-pointed and not nearly as elastic as the English steel pen, and are much less so than those of our Vienna manufacturer Karl Kuhn.

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As regards pens, the United States were represented at the Exhibition only by the gold-pen manufacturers, and several important firms making this glistening instrument were well represented. It is generally known that it is not the gold but the point, composed of rhodium and iridium mounted in gold, that gives the instrument its value in writing. Treated with care, this point remains unchanged for years, and affords the advantage of enabling the writer to use the same pen for a long time. For children, at least in our country, this pen is too expensive and is not at all in use. The penholders are, in most cases, also made of the precious metal, but, in our judgment, they are too thin.

As to desks, North America exhibited a great variety of them, one-seated ones as well as two-seated, constructed according to the most recent patterns, and that country has proved very fruitful of inventions in this branch of school hygiene. Some of these school-desks are very convenient and elegant, but for common use they would be too costly.

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We cannot but add some concluding remarks with regard to the North American exhibition of school apparatus. The inventors and constructors of desks adopt the inclined plane for writing, but not in

an extreme manner; the inclination is very gentle, in some instances scarcely perceptible. Among the methods of writing the so-called "American" prevails almost exclusively. With simple, neat, oval forms attention is paid especially to rapidity, consequently we find a prevalence of the fine stroke and rarely the application of shades.

The principal representatives of this system are the methods of Payson, Dunton & Scribner, published by Shauttluck, and the eclectic system of penmanship of Tompson & Bowler, by Wilson & Hinkel, of Cincinnati. German penmanship is only occasionally taught.

The national method of Tompson & Bowler is commendable, as well with regard to the form of the letters, as to the progressive distribution of matter. The Latin or national penmanship is taught in eight copy-books, properly double copy-books, distinct copies being used for boys and for girls. The ninth contains very tastefully executed copies for artistic writing. All the copies are simple, and at the same time elegant. The method uses the fine stroke, a little more pressure being exerted in the oval letters.

The most popular method of penmanship in North America is that of Payson, Dunton & Scribner, which is very good. The method of instruction is the same as in the preceding, but not quite as correct in the form of the letters. Scribner exhibited a large collection of standard copy-books for schools and private instruction, also very fine specimens of the penmanship of scholars.

As in all penmanships, so also in the American national penmanship, alterations in the form of letters are perceptible; but these are, at least, not affected, and are always easily legible. In general, this method is commendable.

A method for instruction in German penmanship was exhibited by Hermann Reffelt, with Steiger's collection of German school-books; but the rather antiquated form of most of the letters, and the rather undeveloped method, do not appear to be very advantageous for a progress in the rather backward state of German penmanship in North America.

Specimens of penmanship.—Besides very pretty specimens exhibited by the different States of North America, very undeveloped and poor ones, also, were seen, an occurrence which, according to our ideas of school matters, should not happen with scholars of the fourth class. It is a pity that the duration of attendance at school was not marked, as well as the age and the class of the scholar, since the choice of class seems to depend, to some extent, on the desire of the pupil.

Some very pretty and elegant specimens of penmanship, by scholars, were exhibited by the public schools of New York and Cincinnati; less excellent ones by Cleveland, Ohio; the German specimens of penmanship, especially, were scarcely passable. The same may be said of Dayton, Ohio. Better results were shown by New Orleans, Baltimore, Boston, Chicago, Toledo, Ohio, and others. We must not omit mentioning that the name of the teacher was given at the end of each separate page.

ADDITIONAL EXHIBIT, No. 6.

THE WORLD'S COMMERCE.

REPORT BY DR. CARL TH. RICHTER.

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364. The cotton crisis during the American rebellion had the effect of introducing into manufacture numerous kinds of cotton which had formerly been considered useless, and thus necessitating the improvement of spinning machinery. Since that time, South America has begun to pay greater attention to the raising of cotton; some countries of Asia and Egypt have pushed themselves into the market, and even Europe has begun to cultivate cotton. A rich and promising cotton district, to which England paid increasing attention, was brought nearer to south and central Europe by the construction of several important railroad lines and the opening of the Suez Canal. Cotton can well afford to pay the canal tariff, and therefore does not arrive in the market at a high price. If we consider all these consequences, it is really surprising that we again find America at the head of the cotton states and as the first in the market.

This is, however, explicable, since America has a good soil combined with labor of ability and endurance, which India and other transatlantic countries have not. Furthermore, numerous plantations of cotton in these countries were merely experimental and auxiliary. They must stand back as soon as the noise of war had been silenced, and the state and people had again rallied. Besides, we must consider that the demand for cotton is continually increasing, and that America is gradually beginning to manufacture its own cotton goods. American cotton is also the best, and most of the spinning establishments of the world have been arranged for cotton of American growth. The progress of spinning machinery has not been as rapid, and, above all, has not spread so rapidly as to prevent the general revival of American production. Neither may we forget that the main land of communication for cotton, England, has had a commercial correspondence and a connection for one hundred years with America; and it is natural that it will return to that producer of its raw material.

It was, therefore, immaterial to America how much cotton other countries sent by way of the Suez Canal to Austria via Trieste, to Germany via Venice, or to Russia via Odessa, or whether Egypt sent cotton to Central Europe by way of Trieste and Venice. Thus the American cotton, with its clear whiteness and silkiness, its great length and strength, retained its good position and partially drove away the cotton of Siam and of the English possessions, which is short, rough, unequally strong, and is not silky, and which can only be employed for lining; it rivals

the queen of all kinds of cotton, the pearly, brilliant, and long stapled cotton of Hawaii, and other kinds from Australia found in the English market, where they are only used.

DRUGS.

Report by K. D. Ritter von Schroff.

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365. The United States of North America brought several of the barks and roots used for medicinal purposes through the firm of McKesson & Robbins, of New York; also the fluid extracts prepared from them, seven essential oils, and a large number of pills covered with a coat of gelatine, which seem to be very popular in America and are generally used. The barks are taken from *Myrica cerifera*, *Gossypium herbaceum*, *Viburnum opulus*, *Ulmus (fulvus?)*, *Cornus florida*, *Populus tremuloides*, *Xanthoxylum fraxineum*, *Laurus sassafras*, *Enonymus atropurpureus*, *Cerasus serotina*, *Hamamælis virginica;* the roots come from *Trillium pendulum*, *Apocynum androsæmifolium*, *Leptandra virginica*, *Rubus villosus*, *Sanguinaria canadensis*, *Cimicifuga*, *Caulophyllum thalictroides*, *Corallorhiza odontharriza*, *Inula Helenium*, *Iris versicolor*, *Panax quinquefolium*, *Coptis trifolia*, *Hydrastis canadensis*, *Veratrum viride*, *Hydrangea arborescens*, *Asclepias incarnata*, *Arum triphyllum*, *Podaphyllum peltatum*, *Statice caroliniana*, *Cypripedium pubescens*, *Asclepias tuberosa*, *Spigelia marilandica*, *Phytolacca decandra*, *Nymphæa odorata*, *Nuplar advena*, *Eupatorium purpureum*, *Aralia undicaulis*, *Polygala Senega*, *Aristolochia Serpentaria*, *Symplocarpus fœtidus*, *Asarum canadense*, *Convallaria multiflora*, *Aralia racemosa*, *Stillingia sylvatica*, *Helonias divica*, *Baptisia tinctoria*, *Rumex crispus*, *Gelsemium sempervirens.* All these are in glasses of medium size, and therefore only in very few samples, while those in glasses of corresponding size exhibit nothing new. Some of them are already employed with us for years in medicine, while others are still the objects of animated discussion; this is particularly true for *Veratrum viride*, which was said to possess specifically different properties from our *Veratrumarten.* Our investigations made upon the roots of *Veratrum viride*, with regard to pharmocognostics and pharmacodynamics, have determined that its properties, with regard to the former, coincide with those of our *Veratrum Lobelianum*, Bernh., and that, qualitatively, its action is the same with regard to pharmacodynamics as that of *Veratrum album*, Bernh., of Switzerland, while it is weaker quantitatively. From this we see that our kinds of *Veratrum* fully cover all our requirements. The fluid extracts were produced from most of the above barks and roots, in the cold way, by repeatedly replacing the exhausted material by fresh. Every fluid-ounce of extract represents an ounce of the material used. Besides these there were also fluid extracts from *Chelone glabra*, *Eryngium aquaticum*, *Galium Aparine*, *Geranium maculatum*, *Erechthites hieracifolia*, *Epigæa repeus*, *Spiræa tomentosa*, *Lobelia inflata*, *Chimophila umbellata*, *Smilax officinalis Stillingia sylvatica.*

The essential oils exhibited were those from *Mentha piporita* and *Mentha viridis*, of *Hedeorna pulegoides*, *Laurus sassafras*, *Tanacetum vulgare*, *Gaultheria procumbeus*, *Chenopodium anthelminthicum*.

From among the pills coated with gelatine, we will only mention the three kinds of quinine pills of varying weight, the asafœtida pills, the blue pills, which are in great favor with Americans, and several laxative, iodine, and ferrous pills. The method of giving the pills a coating of gelatine seems to be worthy of imitation in cases where it is desirable to prevent a disagreeable odor, or the drying up and consequent shrinking of the pills. Besides these pills coated with gelatine, there were a great number of pills of various contents, covered with a mixture of corn-starch and sugar. They were exhibited by the firm of W. M. Warner & Co.

FAT, AND THE PRODUCTS OF DRY DISTILLATION.

Report by Dr. Heinrich Schwarz.

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366. Considering the immense production of cotton of the whole world, it seems very remarkable that it has not been attempted sooner to obtain the oil contained in the thick seed which is separated from the clean cotton. Even in the Southern States of the republic, which long held the first place in the production of cotton, and which belong to a country possessed of such a well-developed industrial spirit, the cotton-seeds were allowed to rot on the manure-heaps up to about fifteen years ago. Now, however, this production has attained great importance, especially since it has become possible to clean the brown oil by strong lye. The American rebellion gave the cultivation of cotton in India China, Egypt, Asia Minor, Brazil, &c., an impulse. In this manner new sources were opened for cotton-seed, and it was exhibited from almost all of those countries. The Bienville Oil Works and Ig. Symanski, both of New Orleans, exhibited some very pretty combinations of cotton-seed and the oil obtained therefrom. The difficulty, which was that the fine fibers attached to the cotton-seed absorb oil, and thereby make the fodder indigestible, has evidently been overcome. Whether the fibers are removed by concentrated sulphuric acid, as was proposed, or not, is a question which need not be answered here. It is said that the refined cotton-seed oil is frequently used for adulterating olive-oil, even for replacing it.

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PRODUCTS OF DRY DISTILLATION.

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367. America did not adequately exhibit its production. The Oleaphene Oil Company, of New York, furnished kerosene oil, and Stephenson Brothers, of Philadelphia, purified paraffine, which was probably also obtained from petroleum.

EXTRACTS

FROM

SWISS REPORTS

REFERRING TO

EXHIBITS OF THE UNITED STATES

AT THE

INTERNATIONAL EXHIBITION, VIENNA, 1873.

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GROUP II.

AGRICULTURE, FOREST-CULTURE, ETC.

REPORT BY PROF. EL. LANDOLT, OF ZURICH.

b. MOWING-MACHINES.

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368. The construction employed by the American manufacturers, Walter Wood, seems to be worthy of special attention for our purposes. The first cost of these machines is not so great as not to pay for the more extensive farms, and of the smaller farmers several can unite for the purchase and use of such a machine, on account of their high capacity for doing work, and in spite of the fact that all would wish to mow at the same time and take advantage of the favorable weather.

GROUP III.

CHEMICALS.

Report by Prof. Emil Kopp, Zurich.

Section 1.—North America.

369. Although the United States have large chemical establishments, that country was represented scantily in that branch.

Henry Bowen, of Philadelphia, exhibited ferrocyanide of potassa and pure glycerine.

John Matthews, of New York, had beautiful apparatus for preparing soda-water on a large scale.

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370. Section 2.—Articles of pharmacy.—The United States exhibited roots and barks, fat and ethereal oils, fluid extracts from roots and barks, and a considerable number of pills coated with gelatine or with sugar and maizene. The large and splendid apparatus of White & Co., of New York, for manufacturing sparkling beverages, alcoloids, and bromide of potassa were prominent.

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371. Section 3.—Mineral oils and fats.—From among the exhibitors of the different countries we mention :

North America.—For cotton-seed oil the above-named firm, Bienville Oil Works and Ig. Symenski, of New Orleans ; for lard-oil, candles, and soaps, Proctor & Gamble, Jeffrey & Co., Emery, Gest & Atkinson, Burkhardt & Co., all of Cincinnati; further, Colgate & Co., of New York, Pease of Buffalo ; for lubricating-oils the Eclipse Lubricating Oil Company of New York.

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372. Petroleum.—The most prominent producer of petroleum is North America, (the United States and Canada.) Every one knows the enormous extent which the export of American petroleum to all countries of Europe has attained in the short space of thirteen years, and the influence which this export exercised to a great extent on many branches of our industry, The daily production of the United States (especially Venango County, Western Pennsylvania, where Oil Creek, Titusville, &c., are situated) is on an average 1,500,000 liters. Formerly the crude petroleum was exported; now the greater part of it is subjected to a refining process in America, and the refined products are exported.

These products are—

(*a.*) Very light hydro-carbons with a low-boiling point, and therefore very inflammable, (petroleum, benzine, kerosene, neolin, lingroin,) which are much employed, either as illuminating materials in specially-con-

structed lamps, or, in place of sulpho-carbons and real benzine, as cleaning-materials for extracting the fat oils from waste, or for carburizing poor illuminating-gas which gives little light.

(*b.*) The real petroleum, which boils at from 130° to 140° centigrade, the illuminating material for our lamps, which has displaced, to a great extent, the illumination with fat vegetable oils in many districts, especially in small towns and villages.

(*c.*) The residue from petroleum, which is employed for the manufacture of paraffine and artificial lubricants, and for the production of a very carboniferous and excellent illuminating gas.

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The Oleaphene Oil Company, of New York, exhibited kerosene oil; Stevenson Brothers & Co., of Philadelphia, purified paraffine; Charles Pratt, of New York, exhibited astral oil, which is not very easily fired. Anthracene, which is made in large quanties in North America, was not represented at all.

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373. Starch and derivatives therefrom (roasted starch, dextrine, gommeline, starch-sugar) were represented from America by Mr. Erreckenbrecker and Mr. Fox, both of Cincinnati.

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Among the exhibitors of albumen, we must mention—

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In North America, Stein, Hirsch & Co., of Chicago, albumen and starch.

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GROUP IV.

ARTIFICIAL FOOD.

Report by Adolf Ott, at Berne.

374. G.—Wines. Following the geographical order adopted in the Exhibition, we begin with North America. This country, if we are not mistaken, has never before exhibited the gifts of Bacchus. At the Exhibition at Vienna it presented common and sparkling Catawbas, Delaware wine, champagne, and several kinds of sherry. Especially the last named were very favorably received and were declared to be fully equal in quality to the sherries of Spain and Portugal. The sparkling wines also met with general approbation. It is known that the common European grape-vine (*Vitis vini fera*) does not thrive in North America (California excepted) on account of the sudden changes of temperature; even the hybrid being worthless for the production of wine. But North America has more than 600 native varieties, mostly of *Vitis labrusca*, of which, however, a small number only are cultivated. Frederic Heeker, according to his statements, has experimented with 57 varieties; but he has limited himself to 14. In Europe, these grape-vines thrive excellently; they never suffer from frost, and seem to be indestructible. The Catawba, the blue Isabella, the black Sharegrape, and the blue Madeira are the most common. Some kinds bear grapes of common size, as, for instance, the Concord, the North Carolina grape-vine, and others, which, according to Hecker, would be suitable for the climate of the Rhine. The odor and taste of nearly all Labrusca varieties resemble those of Muscat, and vary between vanilla and strawberry. The aroma, which, however, must not be confounded with the flavor of German vines, is generally weak, and disappears altogether when kept any length of time. The Catawba has an excellent flavor, filling the surrounding air with a spicy odor, for which reason this grape should be mixed with other less aromatic grapes in making wine.

In the southeastern part of Michigan a wine is made which threatens to supersede the Rhine wines altogether. Near Monroe, 16,000 gallons were made from a surface of six square miles. A still larger yield was expected for the year 1872.

Statistics concerning the culture of grapes in North America are given below. In this place we may be permitted to insert the following remarks concerning American wine-culture, from a speech made at the Agricultural Congress at Valence, in 1870, by Ferrel des Chênes:

"Shall I point you to America? What is done in that country is not a manifestation of activity; it is a kind of rage. It is astonishing what a number of grape-vines have been and are being planted in Ohio, Delaware, and California. The American does not merely work and

plant in order to harvest; far from it; he studies and examines all methods and innovations; and where the whole population of a country works and thinks, no retrogression is to be apprehended. Every new branch of science has its dangers, it is true; but do not believe that the practical common sense of the inhabitants of the New World would allow them to get into difficulty, or permit them to go a step beyond what will promote their interests.

"A wine-grower wrote to me last August something significant enough to be quoted in this place:

"'Wine-making in California cannot boast of a long experience; but, on the other hand, neither has it to overcome prejudices, and there is no impediment whatever to the introduction of well-tested innovations. The wine-growers of California read the works of your great chemists, from Lavoisier to Pasteur, with profit and with zeal. Pasteur is as popular among the California wine-growers as the President of the United States; and if he were there, they would most certainly confer upon him some high office.'

"As soon as I received a copy of his researches in wine, I heated 20,000 gallons of wine at once, according to his directions, and the result accorded with Pasteur's prediction.

"In accordance with his directions, the California producers of wine air the must in regular intervals during fermentation, in order to promote the access of oxygen to accelerate and complete the fermentation."

In a lecture before the Mississippi Valley Wine-Growers' Association Mr. Busch made some remarks on the statistics of wine-culture in North America. According to his statements, the production in Missouri was 1,000,000 gallons in 1870; that of Illinois 1,200,000 gallons; that of New York 2,250,000 gallons, and that of the other States east of the Rocky Mountains 1,000,000; California produced 7,000,000 gallons. Total production, 12,450,000 gallons. The average price of a gallon was $1.35.

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CONDENSED ARTICLES OF FOOD.

375. *Meat extract.*—In the section of the United States of North America meat extract was exhibited by the Meat Extract Company of San Antonio, Texas. It was stated that this establishment produces annually 200,000 pounds. According to Johan Stingl at Vienna, the above-named extract contains: water, 16 to 21 per cent.; ashes, 18 to 21 per cent.; substances soluble in alcohol, 56 to 66 per cent.

Dr. R. Fresenius gives the following analysis:

	Per cent.
Water	19.68
Ashes	21.08
Substances soluble in alcohol	59.76
Fat soluble in ether	0.16
Total amount of nitrogen	7.152
Amount of nitrogen in the parts soluble in alcohol	6.253

The Texan meat extract, therefore, contains only traces of fat, which, even in small quantities, would be apt to endanger its durability by being subject to rancidity. Its solution in water is clear and fulfills all the just requirements of a good meat extract. Some even find the bonillon made of it to have a milder taste and a more agreeable odor of roast meat than the Fray Bentos extracts.

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376. *Meat and Fish.*—Trebbin, of Copenhagen, preserves larger pieces of smoked beef by covering them with parchment-paper saturated with vegetable acid, and Withaker & Sons, in Saint Louis, use woven bags coated with gypsum and ocher, for the preservation of hams. Both kinds of meat were very juicy and of excellent taste.

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The United States of North America, so richly provided with good food, were represented worthily by some important firms.

Among the preserved foods we will only mention salmon, lobsters, and oysters, great quantities of which are exported. England, for instance, receives no less than 50,000 boxes, each containing 48 cans of preserved lobsters; France and the Isle of Jersey having stopped their production, American oysters are sold in England in cans containing twenty shelled oysters at 8*d.* (20 cents, gold,) a can, and are served up there, as in America, in a great variety of ways.

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377. *Vegetables, Fruits, &c.*—In the United States section our attention was attracted to dried fruit, well cured by the application of steam. This was very much superior to that found in the Swiss department. A new method of closing the jars must be mentioned here. The jars are provided with a cover, which can be turned, and a ring of gutta-percha, which is inserted between the cover and the neck of the jar, serves to close it hermetically.

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378. After this part of my report was in press, I saw an article in the Scientific American, of March 25, 1871, entitled "The Condensed-Milk Manufacturers," containing some remarks on the first efforts of the late Gail Borden, as well as on the extent of the production of condensed milk in North America. I annex an abstract of it as a supplement to what I have said above.

As early as 1856, Gail Borden was convinced that milk could not be preserved in a dry or powdered state without undergoing detrimental changes. He also found that, to preserve milk for a longer period of time, an addition of sugar was absolutely necessary.

In 1861, Borden had already a large sale for his article, and in each of his four or five establishments 5,000 cans were produced daily. During the war of secession his business attained a great magnitude, owing to large contracts for the Northern Army. About that time Borden introduced his plain condensed milk for the population of cities. This

kind of condensed milk is, like the other kind, evaporated to the consistency of sirup, but does not contain sugar. It keeps for one or two weeks, and is much used. In New York, for instance, more than one-third of all the milk consumed is plain condensed milk.

With regard to the extent of this branch of industry in the United States, we can only say that the eight or ten establishments along the Hudson, in Connecticut, Pennsylvania, and Illinois produce 500 boxes, containing each four dozen cans, or 8,500,000 pounds, daily. The export from September 30, 1869, until September 30, 1870, reached the value of $200,000, England alone taking $80,000 worth. A great quantity of condensed milk is shipped to South America, Australia, the East Indies, and China. More detailed information about the extent of this production, for which the numbers given by no means express the average, is yet wanting.

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379. *Supplement to d'Preserves.*—Since the late Franco-Prussian war, a new preserve of beef has been introduced at Hamburg, which excels considerably all productions of this kind, the Australian not excepted.

When, some years ago, Mr. Monroe, owner of the largest pastures and the most numerous herds of cattle in Texas, undertook to produce beef preserves on a large scale, the other land-owners hesitated to join, and were satisfied to sell their cattle to Mr. Monroe.

Finally, they concluded to try the new product. A can of the preserved meat was put alternately on a hot stove and on ice every day during six weeks, to test its durability.

When it was thus thoroughly tested, they bought all the shares of the establishment, and after the death of Mr. Monroe, who was so deserving and indefatigable with regard to this production, and who died soon afterward, the now-existing great joint-stock company was formed at Galveston.

The manufacture is carried on as follows: The best meat of those innumerable oxen, fattened on the nourishing grass of the prairie, serves as raw material. In Texas, only the skin of the cattle is of value, the meat being nearly worthless. This circumstance explains the fact that the above-named establishment makes use of only the best parts of meat, rejecting all the rest, that is, working it into manure. The fresh meat, entirely freed from bones and sinews, is pressed into three, four, or six pound tin cans, the covers are soldered, and the cans are put into boiling water for about three hours. The included air expands, bulging out the cover. This is pierced in the center, and after the included air has escaped through this little hole, it is closed up immediately. The cans are varnished and ready for shipment.

The manner of using it is very simple. The upper part of the can is detached by cutting it half an inch below the cover with a pair of shears; the can is inverted, and thus the contents are empted, consisting of meat jelly having an agreeable odor of roast meat, and some fat.

A sufficient quantity of salt is added, and the whole mass is quickly heated and forms an excellent stew, the fibers of the meat being exceedingly tender. On account of its condensation this meat soon satisfies the appetite, a quarter of a pound being sufficient for one person, bread or potatoes being provided in addition. To make the gravy a little more substantial, some flour, browned with fat, is added. Or, if a greater quantity of gravy is wanted, an addition of a weak solution of the meat-extract of Liebig will answer the purpose. For a change, an addition of pepper, minced onions, and vinegar will make a splendid ragout.

The writer has tested this preserved Texan meat several times in his own household, and uses it once every week, when an acceleration of culinary work becomes necessary for domestic reasons.

The cheapness of this article makes its use a direct saving. No European establishment will ever be able to furnish such an excellent and cheap product, because it lacks the excellent raw material, of which Texas has such an abundance that it is nearly worthless there, and on account of the low wages in Texas. In six-pound cans, it comes to about seven silver groschen (20 cents) a pound; in smaller cans the price is a little higher; in larger quantities a considerable discount is allowed.

We need not point out minutely the value of so excellent a preserve for armies in time of war. The provision-trains might easily carry a supply of this meat for several days for the whole army, and thus supply a wholesome and nutritious change for bacon and *erbswurst*, (pea-sausage.) The sanitary department would have no difficulty in carrying large quantities of this preserve, and who of my colleagues would not welcome the opportunity to be able to furnish nutritious and palatable meat, even under the most difficult circumstances, to hundreds of sick and wounded soldiers, immediately after the establishment of the field-hospital?

The great facility of preparation, (*which beats the erbswurst*,) the possibility of eating this meat unprepared, being an excellent food in this state also, the easy manner of serving out, on account of the absence of bones, sinews, &c., are of the highest importance to soldiers, especially when the enemy is near and the preparation of meals is hurried.

The stores to be kept in time of peace might easily be disposed of for manœuvers and replaced by a fresh supply.

I hope this short and accurate statement may produce a more thorough investigation by competent persons.

GROUP V.—SECTION II.

TEXTILE INDUSTRY.

REPORT BY JB. STEIGER-MEYER.

380. COTTON-SPINNING.—North America has partly emancipated itself since the war by assisting home production, and only imports the finer goods from Europe. It is expected, with confidence, that North America will begin to export its cotton fabrics, and will compete with England on the markets of China, India, and South America.

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381. COTTON-WEAVING.—Among the extra European countries North America takes the first place in the cotton-industry. This industry has made rapid progress under the high protective tariff, and the favorable circumstance of the vicinity of the raw material. It has already 9,000,000 spindles, or as many as Germany and France taken together, and 160,000 power-looms. In the cotton-industry there are 956 factories, paying about 200,000,000 francs ($40,000,000) wages. *Europe must prepare itself for losing the custom of North America for all articles which can be made by machinery.* This will be an almost irreparable loss for Europe, and the reaction upon all classes can scarcely be estimated. We cannot avoid the impression that the zenith of the industrial superiority of Europe was included in the period from 1850 to 1880, and that the time is not far distant when America will not only surpass us in mechanics but in all industrial branches. We find there a freedom of development, a richness of soil, and an abundance of mental strength and energy opposed to which Europe appears like a pedantic old matron.

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382. PRINTING AND DYEING.—North America was not represented by printed fabrics. The general belief is that America still draws its principal supplies from England and Alsace; but this has changed materially since 1867. North America now produces all its common printed fabrics, and only receives the finer articles from Europe, as its spinning and weaving establishments are not yet arranged for finer goods. The coming years will, however, materially change this, since the development of the cotton-industry is making rapid progress in this direction also.

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GROUP VI.

LEATHER AND HIDES.

Report by Ernest Mercier.

383. Sole-Leather. America, (United States,) of which the principal exhibition consisted of sole-leather, exhibited leather tanned with the bark of hemlock. This method of tanning is very good, but does not equal that with oak bark; the color is a deeper red, and the fibers are not close enough, which makes it more spongy and less durable. We must, however, add that it is tanned quicker, and that the price is lower than that of sole-leather in Europe, for it only costs 27 cents per English pound in the United States, which is equal to 3 francs per kilogram, while the cheapest sole-leather in France or Switzerland costs at least 4 or 5 francs per kilogram. Sole-leather tanned with oak bark is also made in the United States, and there were several samples exhibited which were well tanned and much superior to the hemlock-leather; but its price also rises to 37 or 38 cents per pound; that is, 4 or 4.2 francs per kilogram. The hemlock-leather is imported in large quantities into Europe, and can compete with certain sole-leathers manufactured in Germany on account of its low price.

In general, the manufacture of sole-leather has made considerable progress in the United States since a few years.

GROUP XIV.

II.—WATCHMAKING.

REPORT BY DR. ADOLPHE HIRSCH.

384. America did not send a single watch. Two exhibitors showed unfinished parts of clocks, reduced to their most simple motions. Above all we must regret the absence of exhibits from the large watch-factories that have been founded in America under the protection of the high tariff by which the United States repulses our products. These factories have been developed especially by the continually-increasing use of magnificent machinery.

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A kind of rudimentary clock, at a very low price, is manufactured by machinery in America; and the manufacture amounts to about 150,000 clocks annually at a price of 1,000,000 francs, ($200,000.)

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GROUP XVI.

AMERICAN GUN-FACTORIES.

385. This country was represented by the Remingtons, who have erected a large factory in which they can make 1,000 rifles daily. They state that they have already supplied over 600,000 rifles. Their machinery is driven by engines of 320 horse-power, and they employ from 1,300 to 1,400 workmen.

They claim to have effected some improvements on the original model, which latter has been known for years, namely:

1. The addition of a half-cock, which prevents full cocking before the barrel has been closed.

2. In order to prevent the wedging-in of the trigger, which is said to occur sometimes, and which makes the charge explode prematurely if the barrel is closed rapidly, they have introduced a motion which is said to draw the trigger back every time.

In order to prevent the barrel, &c., from rusting, nickel-plating has been applied, which costs $1.25 per rifle; it is suitable for sporting-weapons, but is too expensive for weapons of war. It is said that fire-arms prepared in this way have stood the test for three years; but the nickel-plated parts are too bright, and therefore are not suitable for army-weapons.

Sharp's system, with a perpendicular motion of the closing apparatus, was also represented; and this weapon also has been furnished with a half-cock.

The Government factories at Springfield exhibited the American Army rifle, of which they can manufacture 300 daily, and which resembles the Amsler-Milbank system. In America they are very well satisfied with this weapon and are in no hurry to substitute one that closes more rapidly, as they expect that considerable progress will soon be made in the construction of rifles and their manufacture. There certainly can be no doubt of this.

Captain Meigs's repeater.—Meigs' repeater is a weapon which holds fifty cartridges, weighs 8½ pounds empty and 12 pounds when charged. This very ingenious weapon may be put together in 2½ minutes. It allows of shooting fifty shots in one minute with some exertion, but at least thirty shots easily, or one every two seconds, the gun being constantly held in position, and only a slight motion of a slide below the gun, forward and then back again, being necessary to charge it. This slide is protected by a guard, which also protects the trigger.

The magazine is in a sheet-brass stock and consists of a cylinder with five compartments, into which tubes of ten superposed cartridges are placed. When one of these tubes is emptied, the next one comes into

play by an automatic rotation of the cylinder; and when fifty shots have been fired a new charge can be inserted rapidly.

The projectiles for the improved instrument of death weigh 19.42 grams, and the charge of powder 3.88, so that a flat trajectary is obtained. Captain Meigs's gun is only to be used within a range of 600 yards, and it is then supposed to receive the advancing enemy with such a shower of bullets that not a single man shall remain to tell the tale. Captain Meigs is especially emphatic in opposing the cartridge-bags of old construction, which are said to disable the soldiers on a long march. He therefore carries the above-mentioned tubes in a knapsack on the back, and believes that the foot-soldier will seldom fire all of his fifty shots. For every three feet that the enemy's cavalry advances on a trot, it will receive one well-aimed shot from each gun, and the same for every six feet when it advances at a gallop. The infantry which advances 325 feet a minute would receive fifty shots, at the rate of one shot for six feet, and it would, therefore, be utterly impossible to approach any position from which a steady fire could be kept up.

If armies were equipped with such apparatus, war would soon cease, since men enough could not be found at whom suitably to direct the ammunition.

The mechanism of this repeater does not seem to be very complicated, and, according to the statements of Captain Meigs, 10,000 shots have been fired through it without necessitating cleaning, and merely with the addition of a few drops of oil at the parts exposed to friction.

Bayonet-shovels, by Alexander, from Philadelphia, in the American section, deserve to be mentioned as a curiosity. He had a shovel without handle, which was attached to the steel bayonet-bladé by means of two steel loops instead of a wooden handle.

Section III.—Sanitary Means.

I. Hospital-cars.—9. American hospital-cars.

386. This was exhibited in model by Mr. Evans. A very long American passenger-car is also arranged for thirty beds in three rows, one above another, with a passage-way in the middle, by removing the seats and replacing them by uprights with the necessary supporting apparatus. At the ends of the cars two small rooms are made, one of them being for the attendants and the other the water-closet.

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V. Litters.—1. The American litter.

This has the advantage of being capable of folding up, although it has four feet, and the bars are made of square oak joined by two iron braces. These can also be folded up in the direction of the length of the bars. The litter also has an adjustable support for the head. The cloth is common canvas nailed to the bars. This litter is said to weigh thirty pounds, which loads the attendant pretty heavily.

ARMY.

Report by General Hans Herzog.

387. North America.—Unfortunately, there was no one in the American department who could give the necessary information about the articles of equipment which were exhibited.

The United States War Department and the firm of Schuyler, Hartley & Graham, of New York, exhibited uniformed mannikins with complete equipment, and also the saddlery of the American cavalry on a wooden horse. The uniforms are similar to those used in Europe and are not remarkable. On the other hand, the equipment of the infantry and the cavalry contains many points of originality. Instead of the knapsacks, the infantry is provided with bags, which are carried over the shoulder, and the covers of which consist of seal-skin, which protects them well against the rain. The inside of the bag is divided into compartments by canvas walls, which assist materially in stowing away the smaller articles of equipment. This bag is carried at the small of the back; this position does not seem to be a very good one. The blanket is rolled up and is carried above the bag, being held by two straps. The canteen is made of tin and is covered with woolen cloth. The cartridge-boxes are attached to a broad belt and are carried on the hip on the march. The bayonet is carried in the same belt.

The following-described model for the cavalry was exhibited: Two strong black-leather straps are crossed at the right side; the hook for the carbine is attached, while the revolvers are carried at the left side. A sword-belt with a catch is attached to this cross, having two small cartridge-boxes at the left side, containing the ammunition for the carbine; at the right side are two cartridge-boxes for the revolver; and, finally, there are attached to this belt two straps for the sword. This arrangement has for its object, that the horseman may have his weapons and ammunition all together in case of an alarm in the camp, and may be able to arrange everything in a short time when he has thrown on the cross-belts, without omitting any of them, an accident which happens very frequently when they are separated.

The saddle of the cavalry resembles that which the United States Government sent us in 1867. The frame is the same as that of the Hungarian saddle, the sides and forks being covered with strong leather, while the leather on the seat is wanting entirely, as well as any kind of upholstery, so that the rider sits directly upon the saddle-frame.

The latter rests upon a thick blanket. The stirrups are made of wood, and are closed with leather in front. The girth is not attached at the middle of the sides, but at the ends, whence two leather straps run toward the point where the belt is usually placed, and are there joined by a leather-covered ring, to which the girth and the straps are sewed. This arrangement evidently prevents the motion of the saddle on the back of the horse. The impedimenta are carried in two canvas

pouches, which are fastened behind. The blanket is tied on in front, as well as the horse-blanket, which is covered to protect it from rain. At the front of the saddle are also the cleaning apparatus, in leathern bags. Although a halter-strap is provided to which the bit is attached, the horses are not tied, but are chained in camp. At the ends of a chain are two leather rings with buckles, which are put around the fetlocks of the forefeet, thus making escape impossible. The bits are not tinned, but are made of steel, tempered blue.

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GROUP XXVI.

EDUCATION AND INSTRUCTION.

FIRST PART.

REPORT BY F. DE TSCHUDI, DR. OF ST. GALL.

388. In most of the other groups the United States of North America were represented in a manner which was insufficient to attract general attention. On the other hand, they took a part in Group XXVI, which was worthy of a free people proud of its general education. Above all, they were richly represented as regards literature and materials for schools. Their text-books and their journals of education alone bear testimony, by their great number, to the great interest taken in public instruction in that country. The same must be said of the school-books, the books for the instruction of youth, the pictures and the wall-maps, upon all of which articles special care had been bestowed. Among others, seventy States, institutions, and associations exhibited their complete catalogues; the geographical society exhibited its documents, its maps, and its famous photographic views of landscapes, which are extremely beautiful; a number of scientific and agricultural societies also presented their reports. A school-house (described in the Swiss journal of education, the *Schweizer Lehrerzeitung*) was placed in the park and represented the arrangement common in the rural districts of the United States. It was remarkable by the extremely practical character and by the careful attention which the North American pays to everything connected with the school, an attention which shrinks from no sacrifice for obtaining the *best*. The desks and the seats of the Americans, for instance, are superior to those of any other people, (desks for one pupil, with a movable seat, having an iron semicircular back and a fixed foot-rest.)

All the States and Territories, as well as many districts and cities, sent their detailed reports, their statistics, tables of their school organization, and often, also, the photographs of their school-houses, the work done by the scholars during examination, &c. Since the supervision of public schools is exercised more minutely and more stringently by the authorities than with us, it is natural that great importance is attached to their annual reports. These periodical reports continually give a new impulse toward progress and improvement; they keep the interest of the population alive in regard to public instruction; they produce a better understanding of the aims and necessities, being interspersed with observations and notices for teachers about the deceased founders, &c. I have read several reports of this kind, each one forming a large volume; and I have found therein treasures of practical sagacity, of facts for teachers, and of experience in school matters. I am convinced that

there would be no better stimulus for the development of public instruction in Switzerland than a serious study of the original organization of the American school, which, in spite of some singularities and curious methods, rests in the main upon the grand principles of republican and humane institutions.

The American school has developed with extraordinary rapidity, with the enormous increase of population. Saint Louis, for instance, had only 20,000 inhabitants in 1841, of whome 350 children (1.2 per cent.) attended the public schools; in 1861 it had 163,000 inhabitants, of whom 13,000 (8.1 per cent.) children were in the public schools, and in 1871 the proportion was 31,000 (9.6 per cent.) children to 325,000 inhabitants. This is a little more than one-half the number of children of an age which usually compels them to attend school. In 1863, Saint Louis had twenty-one school-houses, and in 1871 it had fifty-two. During this year accommodations have been provided for 6,680 new pupils, and four new buildings, containing forty-eight classes, were still in the course of construction.

It is well known that instruction is not usually obligatory in the United States, being probably due to the respect for personal liberty entertained everywhere; the attendance of the public schools, also, does not correspond to what would be expected from a people attaching such high importance to general culture. This discrepancy is accounted for by the success of private schools, of night-schools, and high schools, and, above all, by the earnest desire of everybody to secure an education. The number of white people of the lower classes who neither know how to read, write, or cipher does not exceed 10 per cent. Nevertheless, the small attendance in the public schools is equally unpleasant to the teacher and the pupil; the number of pupils attending school during the 200 days of session is small, being only a few per cent.—only 33 per cent. attending during 180 days, and as many during less than 100 days; that is to say, one-half of the time.

The organization of the primary school is similar in the different States. The common school, or district school, is subdivided into the primary and the grammar school, a high school. This latter constitutes a perfectly independent institution for young people of both sexes from thirteen to eighteen years of age, and is vastly inferior to our universities.

* * * * * * *

At present, however, we find in several States of the Union (Massachusetts, Ohio, Illinois, Missouri) the idea arising that if we want a prosperous school these dull and formal proceedings must give way to a more liberal method of instruction, always coming back to a common-sense demonstration of things. The text-book will not be taken from the hands of the people. From the first lesson the alphabet or spelling-book is put into the hands of the child, and "it is expected that he will make himself master of it;" the same is done with regard to the arithmetic and the small geography, always with the hope "that he will in

struct himself." The starting-point is the national principle of self-government, and it is asserted, "That which the scholar learns by his own efforts renders him strong and independent; that which is put into his head mechanically has very little value." * * * "The book alone gives complete knowledge." * * * "Every step that makes the scholar more capable of understanding perfectly a printed book, is also a step toward the moment when he will be free and independent of the direct and personal instruction of the teacher. By our system of education we furnish the scholar with the easiest means of educating and instructing himself continually." (Annual Report, Saint Louis, 1869, p. 27.)

"It might, at least, be required that the teacher explain in detail the contents of the text-book, that he teach the child how to read and recite it intelligently; unhappily, this is a task which, it seems, is not yet understood by a number of poor teachers. The teacher who permits the scholar to recite his lesson like a parrot does not deserve to be at the head of a class." (Annual Report, Saint Louis, 1870, p. 185.)

389. It is very interesting to study the contrasts which exist between the German and the American methods; we there find clearly the difference in the national and political principles of the two peoples. While the German teacher carefully prepares the lesson with the scholars, exhibits the rule, or recounts the history to be learned, perhaps reads it aloud in the class before the scholars pass themselves to reading the text, the American teacher merely indicates the task to the scholar, lets him study and ponder over it, and if he does not understand it he has it corrected by the other scholars, according to the principle that "it is not what the teacher does which is of value, but that which he makes the scholar do."

A severe discipline, which does not shrink from using the birch, prepares the young people for independence, as does the instruction. Thanks to a military punctuality in the smallest affairs of each day—arriving at school, sitting down, rising, marching, taking the pen, taking the books, all this without noise, and according to rule—extraordinary results have been obtained. In a colored school, for instance, having 400 pupils, not one arrived late in the course of half a term. The ruling idea is to replace by a strictly moral education the omission of religious instruction, which cannot be taught in the school, so as to accustom the child to govern itself morally. The success attained in this regard is very imperfect, as proof of which we only cite the fact that in no country is there such an undisciplined youth, one which is held to account so little as in the Union.

Instruction is usually not compulsory in the United States, but almost everywhere there exists a school government which is legally established—in Missouri, for instance, since 1833—for all white persons. In several States there is frequently a sufficient contribution for the schools; in others a tax is levied, which provides for all necessities, and no scholarship is deducted, in virtue of the principle, "Our schools

should be good enough for the richest and cheap enough for the poorest."

With the blind and the deaf and dumb good results are obtained in about thirty institutions. We were agreeably surprised to find at the Exhibition editions of Shakespeare and several other classical writers, for the use of the blind.

The higher grade of public instruction was but poorly represented in the American department. It differs widely from that which we call our university studies. Nevertheless, the photographs of the University of California, the reports and bulletins of the celebrated Smithsonian Institution, of the State University of Iowa, &c., without counting several academies, testify to the zealous care bestowed upon higher instruction. A very decidedly practical tendency manifests itself here. The basis of the classical studies disagrees completely with American education.

I do not pretend to pass a judgment on the American school—it is still in its infancy; but, according to my opinion, it contains many precious elements, which may some day enable it to attain the height which the nation already vauntingly attributes to it, and which will allow it to rival the most advanced nations. The mother-country will follow this development with a vivid interest. The German people, especially, could profit by what there is good in the American school, that which favors intellectual independence and the formation of the character for passing on to new progress. It might receive a powerful pedagogical impulse therefrom, without renouncing what otherwise forms its glory and its mission in the world, *to be the champion and the pillar of classical education, the guardian of a high intellectual culture in itself and of sowing the highest and best ideas of humanity for the people to reap.*

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EDUCATION AND INSTRUCTION.

Second Part.

Report by E. Rambert, professor at Zurich.

390. America was also prominent, by the luxury of its small and elegant school-furniture, made so as to separate one scholar from the other. They were, however, made of cast iron, except those parts which are necessarily of wood, the desk, the back, and the strips serving as seats.

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C.

REPORT

OF THE

EXECUTIVE COMMISSIONER.

H. GARRETSON.

VIENNA INTERNATIONAL EXHIBITION, 1873.

REPORT

OF THE

HON. H. GARRETSON,

CHIEF EXECUTIVE COMMISSIONER

OF THE

UNITED STATES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1875.

REPORT

OF

THE CHIEF EXECUTIVE COMMISSIONER.

VIENNA, AUSTRIA, *November* 8, 1873.

SIR: The undersigned respectfully reports to the Department of State the termination of his duties as Chief Commissioner for the United States to the World's Exposition at Vienna.

There were many circumstances attending the acceptance of office by your Commissioner that belong to the history of the Exposition, which have been submitted to the Department by my predecessors, as well as by myself, from time to time. I will make no reference to them now, except to indicate the difficulties attending the faithful performance of their duties by the members of the Commission, and the discouragement which was shared at the outset by ourselves as well as by so many of our exhibitors.

If such reflections have any value now in summing up the results of the Exposition and the position occupied by America, it would be in the gratification we all must feel at the industry and enterprise of our people. Assisted by the liberality of the Administration and of Congress, we were enabled, in spite of many obstacles, to achieve what, I think, will be considered really important results.

An opinion has been frequently expressed that the display made in the American department of the Vienna Exposition was unworthy of our nation; that it feebly represented our resources, and that it did us no honor in an Exposition where we found ourselves in public competition with other nations. This opinion seems to have been accepted at home; but, as a final judgment, nothing could be more unjust. I am willing to concede that the American department was not what an American would desire to present as a type of the industry and genius of his country. In splendor and fullness, and in variety of detail, it could not compare with what was shown at Vienna by nations of more limited resources and smaller population. But there were difficulties in the way of a satisfactory American display—many of them peculiar, unforeseen, and insurmountable.

There was a wide sea to cross; and before the exhibitor could appear in Vienna he was burdened with the expense of journeys by sea and land. There were infinite troubles and embarrassments, disheartening to the exhibitors, many of whom had never been in Austria, and were

strangers to the country, its language, and its institutions. The United States were so far from the scene of the Exhibition, and so little had been done to make its value and magnitude known to our people, that public opinion seemed indifferent. There was no emulation among our artisans and merchants. Between Austria and the great nations surrounding her there was a unity of commercial and business interests, which stimulated competition and display.

The rivalry of trade, the desire for new markets, the direct personal influence of royal rulers, who had the interest of friendship in the success of the Imperial undertaking, combined to give unusual activity to the enterprise of other nations. We had none of these advantages. The action of Congress granting an appropriation for the Exhibition pressed so closely on the opening, that the realization of its liberality was hindered by the delay. Had the commercial relations existing between Austria and the United States approached in magnitude those maintained with England and France, I am convinced that the display would have equalled in wealth and variety of detail the exhibitions of England, France, and Germany. Had our manufacturers and artisans fully appreciated the enormous advantages of the markets which the Exhibition has opened to American industry, their sense of trade and profit would have gone far to stimulate competition. As it was, your Commissioner and those who acted with him, as well as the exhibitors who came to represent our industries, found at the outset difficulties in the way of representative display which could not be controlled.

If anything could add to these embarrassments, it would have been the unhappy differences which attended the acceptance of office.

It is not my duty, nor would it be a gracious task, to dwell upon the causes and history of these differences. They have been considered by those in authority at home, and it has been the constant aim of the commission to deal with the obligations of the office as though no misunderstanding had taken place. We were inspired by the animating thought that, whoever had been worthy or unworthy, it was the duty of the commission to rescue the department; to make the most of the materials in the way of display; to see that every exhibitor had a fair, full hearing before the jurors; to aid the exhibitors in the attainment of diplomas and medals, and various rewards of excellence, and, above all, to demonstrate to the hundreds of thousands who came from other lands, and who saw America for the first time in the Exhibition, that the industry, and taste, and genius of her people were worthy of their universal fame. I speak for the commission over which I had the honor to preside; for the minister, Mr. Jay, whose tireless and patient courtesy met our constant gratitude; for the consul at Vienna, General Post, who seemed to welcome every labor; for many fellow-citizens who found themselves in Vienna as exhibitors, as special agents from various departments of the Government, from States and cities, or as spectators; for those who have represented our journals, and were the historians

of the Exhibition, when I say that this seemed to be the animating thought of every mind. Among all the representatives of America who found themselves in Vienna, we were proud to be able to note that the true American spirit prevailed, and was intensified by the conviction that it was necessary for the honor of the country to labor for its success with energy and harmony. This feeling developed itself as the Exhibition progressed, and bore good fruit.

While some of the other departments made an attractive display in the beginning, only to fade away and to lose all value before midsummer, the American department seemed to grow in interest and value from day to day. In later stages of the Exposition, the fame of some of the machinery and instruments in our Machinery-Hall had spread so widely that curious and interested crowds would gather to observe them, and remain for hours. It seemed to justify the opinion which His Majesty the Emperor of Austria expressed when inspecting our department in detail, that "as a presentation of results of labor, animated by a high degree of intelligence, the American exhibit was surpassed by none."

In accordance with the Imperial programme, the Exhibition was formally opened to the public by the Emperor of Austria in person on the first day of May. The American department was far from being ready for some weeks after the opening; but as other departments were tardy, and as the General Direction were not prepared to furnish steam for our machinery-hall for a month after the time announced, the delay did not practically affect our display.

Among the difficulties which attended the beginning of our work, was one arising from misunderstanding advices received at Vienna in reference to articles forwarded from the United States. We discovered when these articles had all arrived, and were about to be exhibited in the various sections of the department, that we had considerably more space at our command than was necessary. By confining the heavy machinery to the space set apart for us in the main Machinery-Hall, instead of the "annexe" building which had been specially intended for its reception, we were enabled so to arrange our machines as to fill the entire space allotted to us in that hall. This work was performed by Mr. T. C. Pickering, of Connecticut, the Mechanical Engineer of the Department, under whose direction it remained during the Exhibition.

Another difficulty came from the arrangement and disposition of the articles displayed in the main building of the industrial palace. By the regulation of the General Direction of the Austrian government, each article had to be placed in an appropriate group. As the composition of these various groups had been devised with unusual care, and as they represented every possible variety of taste, industry, and science, a country going to Vienna with a representative collection of its resources would find an obedience to the Austrian rule consistent with harmonious arrangement and tasteful display. Your Commission soon found

that, in some of the groups, articles were wanting. In others there was a scanty representation. Therefore, to have carried out the wishes of the Imperial Direction would have given the American department a grotesque and impoverished appearance. It would have prevented our showing in a proper manner the true value of the articles exhibited. Under these circumstances, your Commission decided that the exhibits in the American department should be arranged with reference to artistic effect, and not in exact conformity to the imperial regulations.

The absence of elegant show-cases and the meagre contributions of the finer sort of manufactures prevented your Commission from producing an effect as imposing as that of other countries, where articles of delicate and fanciful construction were made attractive to the eye by costly cases of decorated wood, ornamented panels, and massive plate-glass; so that, when our department was thoroughly in order, the impression which it made upon the casual, as well as the careful, observer was an unjust one.

To those who came to study the real processes and achievements of modern industry, the American department, with its illustrations of the useful and mechanical applications of science to the every-day wants of life, the ingenious adaptation of machinery to agriculture, the wealth of national resources in the collections of raw products of coal and cotton and iron, more than compensated for the absence of those more attractive elements which went so far to give popularity to the exhibitions of other countries.

While dwelling on this point, I can do nothing better than quote the observations of Prof. R. H. Thurston, Member of the Scientific Commission, as furnished to the undersigned in a report, a copy of which has been already transmitted to the Department. In this report Professor Thurston shows that many groups in our display were fairly, and others but imperfectly, represented, and regrets the absence of products and industries of the country which would have been of greater value in Vienna. He remarks:

"I regret to report that a most unfortunate deficiency is observed in other departments, not even excepting Group XIII, although I believe that the Department of Machinery bears comparison with similar departments of other nations, far better than our exhibition in any other division. In every department in which our people excel all other nations, we are entirely unrepresented; in others, in which we stand equally well, our exhibition gives to strangers a very inadequate idea of the ingenuity of our mechanics, of the skill of our operatives, and of the neatness and efficiency with which our machines do their work, or of the directness and effectiveness of our general methods, and of the peculiar excellence of many of our products. Very rarely, if at all, do we find any one branch of our industry well represented as to processes, machinery, or products. It should, however, be remembered that, while the United States is thus most imperfectly represented, and while

strangers can gather from the inspection of our contributions but the slightest possible evidence of the state of the fine or the useful arts in our country, we may at least claim, without fear of contradiction, that what we have here presents a greater variety, and a larger proportion of real native exhibits, than can be found in any other section of the Exposition."

I may say here, in addition to this statement of the views of Professor Thurston, that the number and variety of articles in our American department increased considerably during the month of June by arrivals from the United States by way of Hamburg and Bremen. In fact, some of our exhibits came to us as late as in the month of July.

By the catalogue which accompanies this report,* a copy of which has already been sent to the Department, you will observe that the number of distinct exhibits in the American department amounted to 922. The number of exhibitors was considerably less than this, as in many cases the same persons entered various exhibits, while in other cases single volumes of reports and documents in the collection of books were entered in the catalogue as special and separate exhibits.

The preparation of this catalogue was assigned, by my predecessor, to Eben S. Brewer, esq., to whose industry and intelligence we owe one of the best-arranged catalogues that was found at the Exhibition. In order to add to its value, it was deemed wise to give our exhibitors the advantage of a brief description of their articles in French and German as well as in English. The commission incurred the expense of adding to the original catalogue prepared by Mr. Brewer the French and German translations.

There has been some comment in various circles upon the method of appointment of jurors to decide upon the diplomas, the medals of progress and merit, and the other prizes awarded to the exhibitors. By the instructions of the State Department, the duty of nominating, and virtually of appointing, the jurors who were to represent America in the International Congress of Jurors, devolved upon the members of the Scientific and Artisan Commission. This was by far the most important duty connected with the work of your Commission in Vienna. Before any criticism is made on the manner in which it was performed, we should remember some of the difficulties which surrounded the Scientific and Artisan Commission. The number of American citizens in Vienna qualified to act as jurors was at no time large. The summer was unusually warm; there were rumors of a cholera-epidemic, which made the Austrian capital, so far as visitors were concerned, practically an abandoned city, during the time when it was expected that thousands of Americans would be present. While the opportunity of selection in the first place was thus limited, few of those who came remained on duty long enough to justify their appointment. Consequently, the jurors selected were chiefly members of the Scientific and Artisan Commissions. As to the

* See Introduction to these Reports.—EDITOR.

manner in which they discharged their duties, there has been little cause of complaint.

So far as I can understand, the general feeling of the exhibitors is that they were well represented by the jurors, and that they received from the Austrian government a fair proportion of the honors of the Exhibition. Attached to this report, is an official list of the awards given to our exhibitors.*

At the same time, I regret exceedingly that, while America was generously honored by the International Congress of Jurors, there were a few omissions of articles of unusual merit. Convinced that this was an oversight, not surprising when so many thousands of articles were to be considered, your Chief Commissioner addressed himself to the General Direction, and earnestly requested a supplementary recognition of the claims of these meritorious exhibitors. Although the General Direction showed every anxiety to meet the representative of the American commission, the efforts in this direction were only partially successful. It was justly observed that, if the imperial direction entered upon the work of re-examining the awards of the jurors, it would be to say virtually that what had been done was valueless, and to direct a new canvass of the Exhibition. This was impossible, and your Commissioner confined himself to the demand that articles of conspicuous celebrity and merit should not be permitted to pass out of the Exhibition without recognition.

It must be said, however, that in some cases this absence of recognition was the fault of the exhibitors themselves. Some of the most valuable articles sent to Vienna were unaccompanied by an agent. There was no one present to explain their merits or value, their use, origin, or cost. Consequently, when the jury attended to make observations and awards, they had no data upon which to arrive at a just conclusion. It was rarely that any exhibition, properly attended to by the owner, and carefully brought to the attention of the jury, was overlooked. The jurors, not only from our own country, but from other nations, dealt with all the industries of the world, as represented in Vienna, in the most liberal and judicious manner.

By the regulations of the State Department, the members of the Scientific and Artisan Commissions were instructed to report on the character and condition of the American exhibition, and to make separate reports "upon inventions and foreign products displayed, which are most advanced in the sciences, arts, and industries; giving a practical description of the methods and processes connected with such products; and also to make similar reports upon the mineral and agricultural products, and of raw materials and manufactures of general celebrity, or displaying remarkable skill and merit; upon implements, machines, and tools; upon metallurgy and the arts in general; upon products of chemistry, and of preparations of food and clothing, and of any other

* See Introduction.—EDITOR.

subject connected with the Exhibition, and relating to the material moral, or intellectual well-being of the nation."

The duties thus imposed upon the Scientific and Artisan Commissions render it quite unnecessary for your Commissioner to enter now upon discussion of any of the questions embraced in their instructions. This report is therefore confined to such observations as come strictly within the scope of the executive Commissioner.

Very soon after the arrival of the members of the Scientific and Artisan Commissions in Vienna, they applied to the Executive Commission for office-room, furniture, clerks, interpreters, draughtsmen, stationery, and printing. The demands were granted, as being reasonable and necessary. Subsequently a request was made for the purchase of illustrated and other books; for architectural drawings and models; for money to pay traveling-expenses, for the hire of carriages and transportation.

Your Commissioner had every disposition to facilitate the members of the Artisan and Scientific Commissions in their labors, and, in dealing with them, he used the utmost liberality consistent with his obligation to the Government; but not finding himself instructed to accede to these supplementary requests, he was compelled to refer the whole subject to the State Department for consideration.

There was another difficulty, which was the subject of some comment, and at one time threatened to imperil the success of the American department. It seems that the Austrian General Direction, in a document issued in the latter part of the year 1872, in reference to the Exhibition, announced that a charge would be imposed on the different nations participating in the Exposition for the space which they would respectively occupy in the palace of industry, machinery-hall, the annexes, and the other parts of the Exhibition ground.

The undersigned was informed by his predecessor, General Van Buren, that the Americans had been duly notified of the resolution of the Austrian government, and made aware that they only could exhibit by becoming responsible for the value affixed to the amount of space occupied. When the charge was imposed by the Direction, some of the exhibitors were reluctant to make payment. Some were unprepared, others absolutely refused to recognize the claim. As the intention on the part of the Austrian government had been announced in the beginning, and as the exhibitors were made acquainted with it when they obtained their permits, good faith compelled from us a prompt compliance with the demand. In cases where the exhibitors persistently refused to recognize the claims, your Commission forwarded bills for the amount. The unpaid bills for the expenses of installation will accompany the articles when reshipped to the United States. It remains for the State Department to consider the best means of enforcing the payment of these claims.

Your Commission paid to the Austrian government, for the use of

space, the sum of 22,434 florins; the amount collected from the exhibitors was, say, 16,000 florins. The difference between these two amounts, which in good faith the Commission felt bound to pay to the Austrian government, and the amount collected from the exhibitors, is 6,434 florins. The amount charged for the space occupied by the American school-house, the annexes to the Machinery-Hall, built by our Government, and other educational institutions and Government exhibitions, was paid by the Commission.

The accounts of receipts and disbursements of the Commission have been forwarded weekly since May 19. The entire receipts are as follows, as shown by the documents of the Commission:

	Austrian florins.
Proceeds of drafts drawn by John Jay on Clews, Habicht & Co. in favor of C. J. Spang, temporary commissioner:	
April 30	£500=5,462.55
May 5	500=5,462.55
Proceeds of drafts of John Jay on Clews, Habicht & Co. in favor of H. Garretson, United States Commissioner:	
May 20	1,000=11,094.25
June 3	1,000=11,062.00
June 11	1,000=11,150.00
June 19	1,000=11,340.00
August	1,000=11,150.00
Proceeds of drafts of John Jay on Morton, Rose & Co. in favor of H. Garretson, United States Commissioner:	
October 31	3,000=33,900.00
Amount collected from exhibitors for space and installation expenses	19,583.18
Total receipts	120,205.13
Entire expenditure as per statements forwarded weekly, with vouchers for each item	100,110.37
Unexpended in my hands	20,094.76

This statement of expenses covers the disbursements of the American department for freight, installation, rent of the space paid to the Austrian government, wages of clerks and employés of all kinds, and, in fact, the entire cost of the American exhibition, except the salaries paid to the Executive, and Artisan, and Scientific Commissions, and the amount of the appropriation used by General Van Buren in New York.

The salaries of the commissioners were paid by Mr. Jay, and do not come into this account; nor does the Commission know the amount ex-

pended by General Van Buren. The balance in the hands of your Commissioner was 20,094.76 florins, which was paid to the Hon. Thomas McElrath, as instructed by the Department. This amount will be more than enough to pay all the expenses of repacking and reshipping from Trieste, as well as all railway-freights from Vienna to Trieste, of the articles to be returned to America by the transport Guard.

In summing up the results of the Vienna Exposition, so far as the position of America is concerned, it is, of course, a gratification to your Commissioner to feel that an enterprise, begun under so many disadvantages, some of which, as has been shown, were inevitable, was in the end gratifying to all who feel a pride in the industry and prosperity of the country. Considering the extent and character of the prizes awarded to the representatives of other nations, your Commission feel abundantly satisfied with the proportion given to America. While we know that our country might have made a more attractive and advantageous display in the way of information and interest to the multitude who thronged the palace, we also feel that the International Jurors recognized in the articles exhibited the presence of the American character for ingenuity and usefulness.

But even a more important consequence of the Exhibition is the opening of new markets to our manufacturers and the products of our soil. Austria, and the countries depending upon this empire, have hitherto been largely unknown to our people. There were numbers of agriculturists, of artificers, of workers in wood, and cotton, and other textiles, who saw in the Exposition building the natural resources of the country and the progress America had made in the production of ingenious machinery. Above all, there were thousands of farmers who till the great plains of the Danube, and who were made acquainted, for the first time, with the variety and necessity of the many agricultural machines which have been invented in the United States. As a direct consequence of this, most of our exhibitors who had articles of a useful character were enabled to find a ready market in Vienna. Many of them received orders for manufactures that will take a long time to supply, and your commissioner is confident that a necessary consequence of the introduction of American machinery into the Exhibition will be to establish a steady, prosperous, and valuable trade between the United States and Austria. I have no statistics available to give you an exact idea of the value of this commerce, but the result of my observation is, that we have more than repaid the expense incurred by the Government and the exhibitors, by opening this new country to the American genius and industry of the future.

I might conclude the report with this hasty survey of what has been done, leaving to the gentlemen of the Scientific and Artisan Commission the discussion of the special topics of interest in Vienna. I am persuaded, however, that it will not be thought improper for me to say something on another question of unspeakable interest, at this time, to every American.

As our country will be the next to open to the world a Universal Exhibition, it was my constant study while in Vienna to gather all available information in reference to the practical operations of the Exposition. I felt that we might improve by those lessons, accepting what was good, and avoiding the errors that may have been committed. The result of these observations is that, while in many respects it will be impossible for the United States to repeat an exhibition like the one at Vienna, upon the same scale, or embracing so many nationalities, yet there is no reason why, by proper management, our World's Fair in 1876 should not be as attractive a display and as useful an exposition of arts, sciences, and industries as any that has ever been held. There will not be that rivalry of nations that was seen between France, England, Germany, and Austria. There is no such competition in trade to justify the merchants of Europe in making special efforts to cross the ocean and subject to the damages of transit articles unique and of unusual value. Many special branches of industry in the Vienna Exposition have no demand in America, and will probably not be brought to Philadelphia. But it was discovered in conversation with the gentlemen who represented other nations, that there was a general desire to be present in Philadelphia with an abundant display of the resources of their countries. I am convinced that, if the Government should adopt a liberal policy toward the manufacturers of the Continent, especially of England, France, Germany, and Austria, the results will be gratifying and surprising.

I cannot overlook the great gratification of the Commission at the universal interest taken in the exhibition at Philadelphia by these representatives. I found the heartiest good wishes, and earnest and friendly desires for success, and an expectation that America would do something at Philadelphia worthy of the fame and enterprise of her people.

In closing this report I have to thank the President and the Department of State for the great confidence shown, for their great patience with my inexperience, and for the constant support given to members of the Commission, in their delicate, trying, and unexpected labors.

I have the honor to be, your most obedient servant,

H. GARRETSON,

Commissioner for the United States to the World's Exhibition at Vienna, Austria, in 1873.

The Hon. HAMILTON FISH,

Secretary of State, Washington, D. C.

D.

FORESTS AND FORESTRY.

J. A. WARDER.

VIENNA INTERNATIONAL EXHIBITION, 1873.

REPORT

ON

FORESTS AND FORESTRY.

BY

JOHN A. WARDER, M. D.,
MEMBER OF THE SCIENTIFIC COMMISSION OF THE UNITED STATES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1875.

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ERRATA.

Page 13, line 10 from bottom, for *Araucania braziliana* read *Araucaria braziliensis.*
Page 15, article 14, line 16, for *nuedo* read *unedo.*
Page 17, line 24, for *Anboden* read *Auboden.*
Page 26, line 1, for *Galiica* read *Galicia.*
Page 34, note, for *Vessely* read *Wessely.*
Page 42, second paragraph, for *Carpinus betuls* read *Carpinus betula,* and for *Leiebiejitz* read *Liebéjič.*
Page 43, in column of remarks, for *Klebani* read *Kubani.*
Page 44, last line, for *terminalis* read *torminalis.*
Page 43, 45, column 6 of tables, read *Baumformzahl.*
Page 45, article 54, for *farming* read *framing.*
Page 46, article 55, paragraph 2, last line, insert a *semicolon* after *old.*
Page 54, line 18, for *Azalia* read *Aralia.*
Page 54, next paragraph, for *ephalonica* read *cephalonica.*
Page 56, line 4 from bottom, for *Faxus* read *Taxus.*
Page 59, article 73, for *campestris* read *campestre.*
line 9, for *terminalis* read *torminalis.*
line 13, for *cenis* read *cerris.*
line 15, for *bintia* read *brutia.*
Page 63, bottom of column 3, for *Plauerkalk* read *Planerkalk.*
Page 68, article 85, line 1, for *Grosspappen* read *Grospoppen.*
Page 72, note, for *Kartbewaldung* read *Karstbewaldung.*
Page 76, article 101, table, for *Kaschan* read *Kaschau.*
Page 78, paragraph 8, for *Cedula* read *Cedrela.*
Page 87, note, for *Banhin* read *Bauhin.*
Page 88, paragraph 3, for *viredanee* read *viridanee;* and for *heras* read *heros.*
Page 88, line 2 from bottom, for *similar* read *smaller.*
Page 89, line 4 from bottom, for *Perac* read *Peruc.*
Page 96, note, for *Fiende* read *Feinde.*
Page 98, article 143, for *Franz Joseph* read *Francis.*
Page 100, note, for *Henzé's* read *Heuzé's.*
Page 102, index, for *Salzberg* read *Salzburg.*
Page 103, index, for *Bounn* read *Brunn;* and for *Lessing* read *Lessino.*

FORESTS AND FORESTRY.

INTRODUCTION.

ASSIGNMENT OF DUTIES TO COMMISSIONERS; IMPORTANCE OF THIS SUBJECT TO THE UNITED STATES; FOREST-ADMINISTRATION IN EUROPE; LEGISLATION DEMANDED IN THE UNITED STATES; LESSONS TO BE LEARNED IN EUROPE.

1. In rendering this report, it may be proper to refer to the letter of instructions received with the appointment of the writer as a commissioner "to observe and report" at the Vienna Exhibition.

In that paper, the commissioners were directed to be present upon the ground, if possible, by the first of May, and to remain until the end of October. They were instructed to organize as a committee, in the presence of the executive commissioner. Upon this committee devolved certain duties, such as the nomination of jurors. The chairman advised the Department of State of its organization, and of the progress of its labors. It is unnecessary here to recur to that part of the history of the commission and of the committee, further than to express individual regret that it became necessary, in some instances, to nominate its members as candidates for appointments upon the International Jury. In explanation, it may be stated that it was found impossible to engage the services of a sufficient number of fellow-countrymen, and those who were obliged, by the duties of their office, to remain in Vienna were forced to accept these additional burdens.

The display was not in any state of forwardness at the middle of May, when all Americans present volunteered their services, and assisted in making up the American department. To the members of the committee this occupation could not fail to prove an obstacle to the performance of the special duty of observation; and the final opening of the United States department of the exhibition was immediately followed by the calling of the juries, of which the duties for the next six weeks were constant and exceedingly arduous.

True, the jury-work did afford access to the material which members desired to examine and report upon; still, it should be borne in mind, this was an examination for award, rather than for report, and it was necessarily much hurried; and, in the heats of summer, members found themselves exhausted with fatigue before they could begin really to execute their officially-prescribed duties in a regular and systematic manner. When every one, from the highest official down to the humblest commissioner, was retreating to the mountains for refreshment

and relaxation, members were obliged to apply themselves assiduously to the great task before them.

When the committee came to look over the enormous amount of material at this 'world's fair,' it was conceded that division of labor was absolutely necessary; and after consultation as to the several qualifications of members and specialties, assignment of topics was made to the different commissioners, and to other American citizens who kindly consented to accept such appointment; but still many subjects of the deepest interest remained unassigned, and must continue without report. To the writer was given the investigation of the products of the forests, as shown at the International Exhibition, upon which is now rendered this report.

First, however, it must be stated that, at an early period in the summer, a request was unsuccessfully made to the State Department for the privilege of extending these researches into the forests themselves, in order to enable the writer to enrich this report with the result of observations upon living trees, and upon many details connected with *forestry*, an art which has grown to great perfection under centuries of nursing in Europe, though quite unknown as an art in our country, where the energies of the people have been bestowed upon the destruction, rather than upon the preservation and production, of timber-trees.

2. This subject of forestry is now claiming, and must receive, greater attention than heretofore. The increasing scarcity of timber within the first century of the nation's history, and that in a country famous for the richness and value of its sylva, and for the extent of its woodlands, is a subject that calls for the most serious consideration of the statesman, and perhaps also for the interference and care of government.

In this matter, it may not be wise to imitate the practices of European states. We have no crown-lands, no royal preserves, no imperial forests nor any church and communal reservations of woodlands. We desire no such tenures, but we do need more forests in many parts of the country than the individual greed of private interests has left us.

The government of a republic need not own forests, but by judicious enactments it may and should foster them where they belong, in the possession of the citizen, and by so doing the good of the many will be conserved. On the other hand, while, as American citizens, we cannot advise the state to become a forester, and to hold large tracts of land, (except as public domain, for the use of the community,) we may be very well content to have our people imitate Europeans in the treatment of their forest-lands. We may learn much of deep interest from experience which has been gathered during centuries of successful practice in an art that has received the careful study of many wise and good men.

3. In Europe, it is found advisable to hold international congresses of the forest-managers of different countries, in order to exchange views of practice, to discuss principles, and to suggest regulations for their

respective governments, to be supported by legislative enactments for the good of all countries, especially where the climatic and physical influences of forests are concerned. Toward the close of the exposition, such a congress was held under the auspices of the Austrian government, and it was presided over by the distinguished minister of agriculture of that country. The convention was composed of representatives from nearly every civilized nation, and contained within its ranks the leading foresters, forest-masters, forest-directors, and forest-counselors of Europe.

4. Our own country, comprising great States, drained by the same rivers, flanked by the same mountain-ranges, and bounded by the same oceans, is situated in many respects just as the aggregate of the several countries of Europe which found it necessary to hold this international congress, except that our glorious Union spreads its ægis over us all, and *national* legislation can be made to apply to the whole vast extent.

In Europe, international action is required, because a single river-basin, like that of the Danube, may sometimes belong to several governments, thus greatly increasing the difficulty of having a harmonious legislation for the protection of forests about the mountain-sources of the streams, to sustain and equalize their flow. Legislation is also needed for preservation of rivers near their mouths, to prevent the drifting sands from obstructing their outlets, interfering with navigation, damming them up so as to submerge extensive tracts of valuable farming-lands, and changing them into unhealthy morasses, or covering them with successive layers of shifting sands that destroy their fertility.

5. From the practice and experience of Europe, we may thus learn the most useful lessons, and it is high time that our national legislature should turn its attention to the prevention of these evils before some of the fairest portions of our country become barren wastes, before the navigation of our rivers is impaired in consequence of their irregular floods and their frequent low water, and before their channels are obstructed by the material that is washed down from their banks and the neighboring hills. These declivities should be kept clothed with forests to a much larger extent than the cupidity of man has permitted in his desire to extend the cultivable area of his farms.

In transmitting this report, the writer feels that he has been treating a subject of vast importance to the future of our country; a subject which deserves, and should receive, much more attention than has heretofore been bestowed upon it by our agriculturists and our statesmen.

The whole subject has recently been so forcibly and so extensively presented to the people of the United States, in the valuable report of Mr. Hough, that it is deemed best, in this paper, to confine the report to the strict letter of the instructions, "to observe and report" what was more immediately connected with the universal exhibition at Vienna in 1873.

CHAPTER I.

NATIONAL EXHIBITS OF FOREST-PRODUCTS.

EXTENT AND VARIETY OF EXHIBITS AT VIENNA; DETAILED DESCRIPTION OF THE EXHIBITS OF ALL COUNTRIES; EFFECT OF PASTURING WOODLANDS; DURABILITY OF SALTED TIMBER.

6. The display of forest-products upon the Exhibition-grounds was extremely fine and wonderfully varied.

Within the palace, most of the nationalities exhibited, in Group II, (agriculture and forestry,) extensive *suites* of blocks as illustrations of the various trees and woody plants produced in the several countries. These were usually of uniform size in each collection, and so prepared as to exhibit the natural appearance, as the split or sawed, and the planed or finished surface also. In many, the bark was retained. In the exhibit from Greece, more ingenuity than taste had been exercised to bring out the desired result of showing combined in one specimen all the peculiarities of the wood. In many of the tropical collections, these collections of samples made a grand display of the wealth of the forests. This was especially notable in the extensive exhibitions sent from the British colonies and the rich display from Brazil.

Beginning with our own department of the grand palace of the Exhibition, the forest-products of different countries will be presented in a rapid survey in the same order they were arranged by the Direction, passing from the west toward the east.

7. NORTH AMERICA.—Neither Canada nor the United States were worthily represented by their forest-products, notwithstanding the great wealth of which we may boast in that line—with our 380,000,000 acres of woodland* in the United States alone.

From the States of Indiana and Alabama, there were cross-sections of some fine trees, such as walnut, (*Juglans nigra*,) ash, (*Fraxinus americana*,) and blocks of pine and other woods, that gave some idea of the size, growth, and quality of the forest-trees, but they were few in number, and were not elegantly prepared. From Louisiana were several bales of southern moss, (*Tillandsia usneoides*,) a natural product of the forests that is considerably used in upholstery, and another article of similar use, from New York, a preparation of wood, called "*Excelsior*."

To see American woods, it was necessary to look into other groups to find the products of our forests in an advanced condition—that is, manufactured—as in the beautiful agricultural implements, the highly-finished musical instruments, but especially in the school-furniture intended to illustrate a department quite distinct from the one under consideration,

* Census, 1870.

but which nevertheless afforded an opportunity for inspecting the beauty and other good qualities of our valuable timbers. Besides these, there were some specimens of carriage-making, especially some wheels in an unfinished state, unpainted, that served to illustrate the superior strength and elasticity of the woods we apply to such purposes, and which enable our artificers to excel all others in the lightness and elegance of the American vehicles for transportation. These wheels excited universal admiration from all observers. Our chief regret arose from the unfortunate fact that there was so great a dearth of the means of illustrating the richness of our forest-treasures.

Nor was this sad deficiency supplanted in any degree by charts nor by statistical tables, which should have been prepared to set before the eye, at least by columns of figures, such data as would have shown the wealth of our resources in this department. Nor are the materials for such tables inaccessible; and it is to be hoped that in our coming Centennial Exhibition we shall be able to point to full exhibitions of all these important products, and to extensive statistical tables and chorographical representations, which shall exhibit the extent and value of our forests and the importance of their numerous products.

8. SOUTH AMERICA.—*Chili* sent a collection of woods.

Uruguay.—The government exhibited several kinds of wood. Another exhibitor sent fifty-two kinds of wood, species unknown; still another showed thirty-four woods for various purposes, and charcoal from twelve different species.

Venezuela exhibited two large tables, each composed of fifty different woods named, besides fine specimens of mahogany, (*Swietenia mahogani.*)

Brazil.—The grand display from this country embraced beautiful polished specimens of the woods of the province of Santa Catharine; the valuable woods of Paraná and of Pernambuco; and also a collection from the Dock-Yard Company at Rio de Janeiro.

By the Forest Company of Paraná was exhibited a collection of the woods of that country, shown in boards, planks, and logs of *Araucania;* also a complete tree of this species thirty-three meters high. This magnificent tree, which was erected in the park, and furnished with its upper branches and fruit, though of course destitute of green leaves, was a most interesting object. This very beautiful species, the *Araucania brasiliana*, abounds in Southern Brazil, notably in Rio Grande do Sul. Santa Catharine, Paraná, St. Paulo, Minas-Geroes, as far as Barbacena. "*Splendor sylvarum!*" exclaims the enthusiastic writer. "Trunk remarkably straight, 44 meters high, 2.30 meters in diameter; wood rather heavy; specific gravity, 0.814; porous, with rose-tinted veins; suitable for ship-building; equal to the pines and spruces; much used in Rio; indestructible by humidity. The bark is thick and spongy, rich in potash, and used by the soap-makers. The knots are red and beautiful for turners' work, and make an officinal charcoal. The seeds contain as

delicate starch as the tapioca. The age of the tree may be known by the branches, which are produced in whorls successively each year."*

From the province of Bahia, also, was a fine collection of wood-specimens. One of the finest was from Pereira de Faro, Rio Janeiro. It consisted of one hundred and fifty blocks from the province of Rio, and contained the principal species of the rich sylva of that country, in which there are said to be three hundred and fifty woody plants.

The forest and other products were also set forth in the literature of the country. The "Chorography of Brazil," by Joaquim Manoel de Macedo, translated into English by H. Le Sage, printed by Brockhaus, Leipsic, gives a very full account of the country and its products. Besides this were the writings of my agreeable colleague, José de Saldanha da Gama, among which were the "*Estudo botanico dos vegetaes seculares*," (from which I have quoted,) "*Cartas sobre botanico*," and "*Synonymia de diversas vegetaes do Brazil*," all printed in Rio de Janeiro.

9. BELGIUM showed specimens of native woods; the NETHERLANDS, oak-bark and tannin, willow-wood. This country made her forest-exhibit by proxy; having few sylvan treasures of her own, she still brought quite a display from her distant colonies, some of which were very interesting. They represented the woods, bark, leaves, and other products procured from a long list of plants growing in Java and other islands of the East Indies; also illustrations of the quinine-producing trees of different species of cinchona that have been introduced into that country from the western hemisphere; these were beautifully displayed.

10. FRANCE, though possessed of valuable forests, contented herself by exhibiting the products from her colonies, which will appear in their appropriate place, geographically, farther on.

There were, however, some specimens of home growth. These were chiefly secondary products, such as bark, cork, and gums; and the Central Society of Puy-de-Dôme exhibited specimens of various woods from the enterprise of reforesting the mountains of Auvergne. Models of apparatus and works on forestry were also on exhibition.

11. SWEDEN sent sections of timber for resonance-boards; sections from large trees; sections from old spruces, firs, and pines; plank, lath, and boards; walnut boards, and the cross-section of a walnut-tree; also young forest-trees for planting.

12. RUSSIA.—The government forest-master of Wjatha showed various products of forest-culture.

The garden-school of Bessarabia at Kischinew exhibited a herbarium, with a plan and description of their garden; also a dendrological collection of the leading trees.

M. Lindes, of Archangel, showed forest-products.

The Lisino forest-school of St. Petersburg showed various products of forest-art.

* *Configura cão e estudo botanico dos vegetaes seculares, etc., por José de Saldanha da Gama, Rio de Janeiro*, 1872.

Nicholas Meierobicz & Co., of Tver, exhibited birch-gum.

Arcadius A. Kaufmann, of St. Petersburg showed ship-timbers.

The Forest Company of St. Petersburg made an exhibit of forest-statistics, samples of wood from the trees acclimatized on the sands of Alesiena, and models of machines.

Basil Greschner presented impregnated building-timbers.

Basil Epichkin, of Tver, had samples of lumber and a model of a saw-mill.

Prince Paskewitsch, governor of Rjasan, exhibited products of forest-art and turpentine.

Count Anthony Potoki, governor of Wolhynia, a part of Russian Poland, showed resin, oil of turpentine, pitch, and birch-gum.

Michael Rajewsky, of Baltischki, had oak cross-ties on exhibition.

Demetri Kusnezoff, of Kharkov, showed building-timbers.

A. Eklöff had boards, potash, and turf.

Nicholas Shelesnoff, of St. Petersburg, showed a model of apparatus for transplanting trees, and a chart showing the extent of propagation of fruit-trees in European Russia and Siberia.

The Forest Institute of Finland had cross-ties to exhibit.

13. SWITZERLAND.—At the annual meeting of the Forest Society in 1872, it was resolved to take part in the Vienna world's fair by making an exhibit of forest-literature, forest-plats, plans of management, a display of forest-tools, and a sketch of the streams used for transport. The standing committee to whom the matter was referred decided upon the following programme:

1. Draughts, models, and descriptions of wood-transport. 2. Draughts and descriptions of some of the wild streams and avalanche-tracks. 3. Forest-statistics, in accordance with the plans of management and charts. 4. Forest-rules, ordinances, and instruction. 5. Forest-literature of the Swiss. 6. Individual forest-products of the mountains.* The whole matter of the exhibition was intrusted to Professors Kopp and Landolt.

14. PORTUGAL.—Resinous products from the state-forest of Leiria and the plans adopted for gathering the crude resin, and for refining it, with the products—oil of turpentine, spirits of turpentine, resin, colaphane, and yellow resin; seeds and cones of the *Pinus maritima* and *Pinus pinea;* woodblocks of the following species: *Acer pseudo-platanus, Alnus glutinosa, Arbutus nuedo, Buxus sempervirens, Castanea vesea, Cerasus usitanica, Corylus avellana, Cratægus oxyeantha, Cupressus glauca* and *lusitanica, Erica arborea, Fraxinus excelsior, Hedera helix, Ilex aquifolium, Laurus nobilis, Myrica Faya, Myrtus communis, Persica indica, Phillyrea angustifolia* and *latifolia, Pinus maritima* and *pinea, Pistachia lentiscus, Quercus coccifera, lusitanica, pubescens, racemosa,* and *suber, Rhamnus alaternus* and *frangula, Salix alba* and *cinerea, Spartium alba* and *juncea, Ulex europæus, Ulmus campestris.*

* From a brochure entitled "*Verzeichniss der Austellungsgegenstände des schweizerischen Forstvereins,*" Zürich, 1873. Professor Landolt.

15. SPAIN had not a very rich display, but there were several entries, among them charcoal, bark, and specimens of various woods; sweet acorns and hazelnuts; selected woods, sundry entries; a display of cork; Forest Guadalajara woods; Forest Lagrono, collection of woods, cherry, chestnut, oak, and walnut-wood; Veterinary School and Institute Leon, woods; province of Burgos, woods, various articles of fir-wood, oak, and beech-wood, charcoal, oak-wood, and holm-oak; Institute Segunda Enseñanza, woods; Cuerpa de Ingenieros de Montes, various woods, olive-wood boxes, oak charcoal, and bark.

16. ITALY exhibited a collection of the leading native forest-plants, (Forest School of Vallambrosa;) xylographic collection of seeds and woods of the leading plants of Friuli, (common school at Udine;) collection from Sassoferrato; collection from Perugia and Forli; cypress-wood from Florence, cones; collection from Royal Park at Caserta and others. Collections of sumac and manna were conspicuous.

Italy has taken a deep interest in the subject of forestry, and is making efforts to restore her sylvan treasures. Extensive collections were exhibited, among which it was easy to see the influence of a milder zone in the character of the plants represented, southern pines, palms, the pistacia, the broom from Mount Etna, (*Spartium ætnense*,) the orange lemon, olive, &c. These were from Salvagnoli Marchetti, director of the Institute of Forestry of Vallambrosa. Her intelligent workingmen were there with an exhibition of their writings and publications,* from which it is apparent that there is yet life and progress in the land of the old Romans.

17. GERMANY.—In this part of the exposition were found some of the richest and most complete representations of the forest-wealth of Europe. This is what we might have expected in a country that has for so long a time occupied the first rank among nations by her forethought in bringing skill and science to bear upon the protection and improvement of her forest-lands.

From the Forest Academy of Neustadt-Eberswalde, there was a fine collection of woods, charts, and tables, embracing plans of the forest gardens of Neustadt-Eberswalde and Chorin; the course of study and catalogue of pupils; earth-charts; the natural history of *Pinus sylvestris*, with preparations elegantly shown in glazed tablets; a display of stuffed animals from the forest, and a large collection of insects, in fifty cases, with the results of their work of destruction; organization and working-plans of the forest experimental stations, and the instruments used; soils, rocks, and their analyses.

* *Statistica forestale regno Italia; Il Ministro di Agricoltura, Industria e Commercio; Castagnola, Florence*, 1870.

Manuale teoretico-pratico d'Arte Forestale; Firenze, 1872; *Giovanni Carlo Siemoni.*

Relazione di risultamenti della coltivazione delle barba bietole zuccherine in Italia, nel 1872, *Nicola Miraglia, Roma.*

Relazioni dei giurati italiani sulla Esposizione Universale del 1867. *volume primo, La Silvicoltura, Giovanni Carlo Siemoni.*

By Dr. Ebermayer, Lehranstalt Aschaffenburg, a collection of philosophical and meteorological instruments, such as he had used at the experimental stations; and from the data obtained by them, the most interesting results, showing the influence of forests, have been given to the world by this professor.*

From the Forest Academy at Münden in Prussia were charts and other illustrations in great variety and perfection.

From Alsace-Lorraine was a fine collective exhibition, in a separate building, in which were woods, bark, minerals, abnormal growths, insects, and various illustrative models, &c., (unfortunately burned before they could be fully examined.)

By the Prussian forestry-department:

From Gumbinen tools for setting out young pines; also an essay on the nursing of young Norway spruce, and another on the Zogge or East Prussian forest-plow, with directions for its use.

From Stettin, instruments for cultivating; the double plow for working the soil in beech-clearings.

From Chorin, culture-tools for plantations of pine in Mark Brandenburg; the Rudersdorfer forest-plow; Eckert's forest-plow; Aleman's underground-plow; hand-sowing machine for pine-seeding, (seed-gun;) boundary-ditch-spade; pinch-spade; and an apparatus for planting yearling pines.

Models of the forest-nursery, by Oberförster Rückert, at Schkenditz; an essay on oak-culture (*auf Anboden*) recommends planting oaks of five, six, and seven years from the plant-beds, oaks four to thirteen from the *Bestandsaaten.*

From the Finanz-Direction of Hanover were forest-tools of the province; wedge-spade (*Keilspaten*) for setting yearling pines; hoes of various kinds, &c., a very complete collection.

From Clausthal, models for transport.

The Grand Duchy Hesse-Darmstadt sent models of saw-mills, &c., and apparatus for bark-gathering.

Grand Duchy of Baden at Carlsruhe, models for floating timber in the Black Forest and of the rafts.

Alsace-Lorraine, a model for transport from Kusian to Strasburg, tools and specimen plants.

By the Prussian forest-management, a collection of logs cut into sections, part polished, part natural, with full statistics as to kinds and product per hectare.

From Trier, oak-bark, as peeled and prepared for market, and statistics of the product.

From Aachen, oak-bark from the coppice-woods.

From Wiesbaden, oak-bark sample; Professor Neubauer's brochure on the quantity of tannin, the results of numerous analyses.

* *Einwirkungen des Waldes auf Luft und Boden, und seine klimatologische und hygienische Bedeutung: Dr. E. Ebermayer, Aschaffenburg,* 1873.

From Baden, Carlsruhe, oak-bark.

From Odenwald and Spessart, Hesse forest-direction, oak-barks, fourteen years' growth from the last cutting.

Gross-Schoenebeck, Brandenburg, a model of a kiln for separating seeds from the cones.

From Clausthal in the Hartz, models and specimens of charcoal, shingle-machinery, wood cutting and carving.

From St. Oswald, in Bavaria, wooden ropes.

Oberzwieselau, Bavaria, resonance-boards, and wooden ware of various kinds.

A board, 30 meters long, from near Frankfurt on the Oder.

Prussian Forest-Department, Berlin, statistic tables showing the area of forests, with entire surface; the kind of management and kinds of trees; all sorts of models; collections of seeds, and also of various trees and shrubs.

The collective exhibition of the Grand Duchy of Hesse was presented with description and special catalogue by the Forest and Domain Directory at Darmstadt. This, like other exhibits of the German foresters, was a model of the application of science to the subject; everything was reduced to a formula; the results were all tabulated, and showed the precise condition and yield of the forests.

First were charts of the whole and of the several parts of the different tracts, instruments for leveling the roads and for measuring the height of the trees; for description and mode of applying these, the reader is referred to the work of the inventor.*

One of the tables gives the name of the five districts, the particulars of planting, a description of the soil and situation, the present age, the mean height, the number per hectare, the amount of wood in cubic meters, and the average annual increase. Illustrations of the growth in the forests: a pine thirteen years old, three years cultivated in crops, 19 feet 9 inches; twelve years old, 9 feet 8 inches; eleven years old, 26 feet 2 inches; an oak stem twelve years planted, set at three years old, and cropped three years, 15 feet 5 inches: another oak, eleven years old, 13 feet 6 inches; an oak-sprout of twenty-five years, from an uncultivated copse, as a contrast to those which had been cropped. This showed the advantage resulting from the cultivation, which kept the young trees free from the choking effects of weeds. In a series of years, with two successive crops, taken at intervals of fifteen years, the average yield, on a total of 1,010 hectares, was 79 hundred-weight of bark per hectare. Some coppice yielded as high as 102 hundred-weight. The lowest average was 57. Implements for utilizing the products from the felling to the finishing; also, a tool we may find useful, the "wedge-spade," for setting out yearling pines in the new plantations.

Products.—The *Hochwald* Coppice. For a century, this has been prac-

* *Beschreibung zweier Instrumente zur Nivellirung der Waldungen und Messen der Baumhöhen, von H. K. Bose, gross.-hesse. Ober-Forstrath, Darmstadt, 1863, Verlag der G. Jung-haus'schen Hofbuchhandlung.*

ticed on the Neckar, especially in the Odenwald. In planting coppice, hazel, oak, hornbeam, and birch are set together. In suitable soils, the oak prevails, and in the cutting of the other woods receives the greatest care for its preservation. Specimens of oak-bark were exhibited.

18. AUSTRIA.—The exhibition of forestry made by Austria was very rich.

The Archduke Albrecht, of Tetschen, Silesia, had a most interesting collection of insects, which was called an "*Entomologisch-biologische Sammlung.*" He also had a separate pavilion, containing the product of his estates in Hungary and elsewhere.

The Imperial Royal Agricultural Society in Görz, Küstenland, exhibited ailanthus-plants.

Czernowitz, Bukowina, had a collective exhibition.

The Society for Reforesting the Territory about Triest showed plants, soils, and various kinds of trees.

A collective exhibition of the kingdom of Bohemia was made by R. von Dombrowski and Dr. Lambl.

The Consorzio Agrario of Trient, in Tyrol, exhibited a collection of useful and injurious insects.

The Joint-Stock Company for Forest Industry at Waidhofen on the Ipps made a display of their products. This establishment is noticed in another section.

Count Carl Althun showed forest-products.

Baron John Bruniki, of Galicia, had a display of split woods.

By the chamber of commerce at Rovigno, in Istria, were exhibited woods, lumber, ship-timbers, and charcoal.

A collective exhibition for Styria from Leoben consisted of forest-products.

The forest-products of Carniola were shown as a collective exhibition from Laibach.

Count Wladimir, of Dzieduszycki, Galicia, had timbers of beech and oak.

Geo. Eder, of St. Johann, Tyrol, showed seeds of Norway spruce.

Dr. Henry Flora, of Mals, Tyrol, had forest-seeds and a design or plan for replanting forests.

The Carinthian Forest Union exhibited various forest-products and statistics.

By the forest-officer of Count Buquoy, at Gratzen, in Bohemia, were shown a collection of young trees for forest-planting.

From the Academy of Maria Theresa, in Vienna, was a collection of forest-products.

The Lumber Company in Vienna showed a group of forest-products.

From the Huttenberger Eisenwerks-Gesellschaft, at Klagenfurt, Carinthia, were woods, charcoal, and a forest-chart.

Joseph and Michael Jenewein exhibited forest-seeds from Innsbruck, Tyrol.

Sigismund Kentner, of Motling, Carniola, had timber, spunk, and phosphorescent wood.

Simon Kosnac, of Sagor, Carniola, showed the model of a self-acting flood-gate for the reservoirs of the water-transport.

The Imperial Royal Agricultural Society of Vienna had a collective exhibition of forest-products.

Prince John Liechtenstein exhibited split timbers, plants, and bast from his estates.

Graf Heinrich Meir, of Galicia, showed a group of cross-sections of oak, ash, and other timbers.

Ritter von Miodecki, of Galicia, made a display of forest-products.

Joseph Niederwieser, of Bruneck, Tyrol, showed disks of larch-wood; and Franz Ortner, of Innichen, Tyrol, specimens of split wood.

Graf St. Potocki, of Brzezany, Galicia, exhibited a fine oak-log.

Karl Ritschl, of Jaispitz, Moravia, showed a large collection of seeds; also agricultural and forest tools.

L. Rueff, of Salzburg, had a collection of timbers and other forest-products.

Alois Schalhammer, of Ehrenhausen, in Styria, exhibited tan-bark.

Franz Schgagknitz & Co., of Botzen, Tyrol, had nut-galls.

Gerhard Schinerdorfer, from Upper Austria, exhibited split wood.

From the Societa Agrario Istriana, at Rovigna, in Kiistenland, were sent forest-products.

Messrs. Stainer & Hoffman, of Wiener-Neustadt, showed a collection of forest-seeds and a model.

Ludwig Trübel, of Vienna, had good boards of the *Picea pectinata*.

Karl Weisshuhn, of Silesia, showed split timbers.

From Joseph Wenger, of Vöklabrück, Upper Austria, lumber and building-timbers.

Messrs. Wohlfeld & Klarfeld, of Lemberg, in Galicia, showed fine oak-timbers for ship-building and railroads.

The Countess Rosalie Zamojska, of Okladow, Galicia, presented a collection of beautiful oak, ash, and maple lumber.

J. N. Zoller, of Sterzing, Tyrol, showed larch seed and resin.

19. CARNIOLA claims to have the richest woodlands of Austria, and her exports of wood are very important. There was a collective exhibition of her forests by the Commission of Laibach. This province is divided into *upper*, *middle*, and *lower* portions. *Upper Carniola*, in the northwest or alpine region, has 47 per cent. of its surface productive—341,856 acres. A great deal of the country is wild and romantic. Among the exhibitors is the Carniola Iron Company, which has 52,500 acres of forest, some of which is at an elevation of 9,500 feet. The species are in the following ratio: spruce, 68; beech, 28; larch, 4 per cent., with scattered firs, Scotch pine, hornbeam, maple, *Alnus incana*, &c. The yearly product is 23,400 normal klafters. The company exhibits young plants from the nurseries, of which there are six, and some

fine logs, various tools, and models of the means of transporting the lumber from the mountains and of the apparatus used; resonance-boards in the rough, split out and finished, and other preparations of wood. Charcoal is an important product. It is made in standing coal-pits, which produce from 84 to 96 cubic feet from á klafter of spruce, and 72 to 84 cubic feet from a klafter of beech. It also exhibited specimens of coal, models, and tools used in the process.*

20. Dr. Anthony Fuchs and son, near Krainburg, have a forest-property of 5,216 acres, at an elevation of from 2,000 to 5,000 feet, part clear spruce, and a part being fir, spruce, and beech mixed. The management is *Hochwald*, with rotation of eighty to one hundred years.

They showed the section of a fir-tree two hundred and sixty years old, of which the stump measured 63 inches; at one-twentieth of its height, it was 60 inches in diameter; height of tree, 120 feet; contents, 1,178.10 cubic feet; annual increase, 4.445 cubic feet.

The section of a one hundred and seventy-year-old spruce, 38 inches diameter; at one-twentieth of its height, it was 36 inches; height, 100 feet; contents, 318.09 cubic feet.

In contrast with these were shown trees damaged by pasturage and stunted:

Sections.	One-twentieth of height; diameter in inches.	Height in feet.	Age in years.	Contents in fractions of cubic feet.	Annual increment.
Spruce	1.00	2.50	30	0.006875	0.000229
Do	1.50	3.00	25	0.018450	0.000738
Do	1.25	2.50	35	0.010625	0.000303
Scotch pine	1.00	2.50	15	0.006875	0.000458
Hornbeam	1.00	3.00	25	0.008250	0.000330
Do	1.00	3.00	20	0.008250	0.000212

Undisturbed growth in a sheltered place—trees of similar age:

Kind.	Diameter one-half of height.	Height in feet.	Age.	Contents in cubic feet.	Annual growth.
Spruce	5.00	28	30	1.910	0.06367
Do	4.25	25	25	1.232	0.04928
Do	5.75	33	35	3.028	0.08651
Scotch pine	3.00	10	15	0.246	0.01640
Hornbeam	3.50	16	25	0.534	0.02136
Do	2.50	11	20	0.188	0.00940
Do	5.00	20	35	1.364	0.03885

* *Katalog der förstlicken Collectiv-Austellung Krains, Landes-Forstinspector Ludwig Dimitz, Laibach*, 1873.

The loss per joch, with 1,600 trees, is thus shown:

	Total contents.	Yearly increase.
	Cubic feet.	*Cubic feet.*
Unpastured woods	3,056	101.086
Pastured and scrubby	11	0.366
Loss	3,045	100.720

or 99 per cent. of possible results. These figures are worthy of the attention of many of our countrymen who advocate wood-pastures.

21. MIDDLE CARNIOLA, lying near the boundary of Küstenland, has 39 per cent. of its area productive; of this, 142,885 joch are wooded. On Prince Windischgrätz's estate, the forest occupies 16,000 joch, chiefly covered with fir and beech, with hazel undergrowth. The manager exhibited average growth of fir in sections of fine size. At eighty years, the contents per log were 182.67 cubic feet. Hazel rods were shown also. Count Carl Lanthieri, of Wippach, has 9,877 joch of forest-possessions, chiefly fir and beech, which yield annually 8,009 normal klafter,* of which 800 klafter of fire-wood and 1,300 klafter of lumber are exported. He exhibited numerous sections of trees, chiefly fir and beech, with their relative situations on different slopes and aspects and elevations noted for comparison. He also showed the various implements used, and the prepared woods.

LOWER CARNIOLA occupies the southeastern part; it is on the eastern foot-hills of the Alps; 43 per cent. is productive, of which 380,675 acres are wooded.

The Prince Auersperg, in Gottschee, has the largest and richest forest-property of the region, being 51,761 acres, occupying the most of the central mountains between Gurk and Kulpa, which are from 1,000 to 4,000 feet high, with a humose calcareous loam on alpine limestone. Beech takes the lead among the trees, then fir. The spruce occurs alone, in patches; maple, hornbeam, scattering; and, when planted, larch and Scotch pine. Cultivation has been continued for fifty years, and about 2,000 joch have been set with the trees named. The annual yield is about 12,300 normal klafter of fire-wood and 7,000 klafter of timber and lumber.

On exhibition were forest-seeds and young plants of larch and spruce; logs of notable size and proportions, with report of their age, contents, height, diameter, annual growth, &c.; prepared woods of various kinds and excellent quality; beech spunk and charcoal, of which 512,000 cubic feet are made for the iron-works. Potash was also shown.

By Moriz Löwenfeld, in Ratschach: This forest contains 3,875 acres; the elevation is from 1,000 to 3,000 feet. Beech constitutes 60 per cent.; spruce, with larch and Austrian pine, 25 per cent.; alder, ironwood,

* The normal klafter contains 100 cubic feet.

and hornbeam, 12 per cent.; and chestnut, 3 per cent. The management is *Hochwald* and clear-cut, (*Kahlhiebe.*) Since 1868, 400 joch have been cultivated with conifers. The annual yield is 800 normal klafter of fire-wood and 100 klafter of lumber. Large quantities are exported as charcoal, fire-wood, and cross-ties.

Exhibited: Fine young conifers from the seed-bed and nursery; models of transport apparatus and wood-ways, one of which is 3,000 klafter long; charcoal from beech.

Baron Gustav von Berg, the Herrschaft of Nassenfuss, has 3,375 acres of woodland, of which 85 per cent. is beech, 10 oak, 5 spruce; altogether *Hochwald*, with a rotation of 100 and of 70 years.

Exhibit: Prepared wood and coal.

Count Gustav Auersperg, in Mokritz, has a forest of 2,000 acres. High beech about 60 per cent., chestnut in *Hochwald* and *Niederwald* 25 per cent., and in the rest oaks and conifers, especially the Weymouth pine, are cultivated. These pines and chestnuts are especially noteworthy.

Exhibited: The results of planting the *Pinus strobus.* This tree has been cultivated in park and forest since 1826, when the plants were brought from the garden of Schönau in Lower Austria. The seeds were shown, of which 30 to 50 pounds are gathered annually. These seeds count from sixty to seventy thousand per pound; from 50 to 70 per cent. of these will grow. A branch with cones and empty cones.

Section of a fifty-year-old tree, 20 inches diameter at one-twentieth of its height; the log is 76 feet long; contents, 59.6 cubic feet. A section of the same log, 33 feet above the stump, is 13 inches in diameter. Young plants from two to five years old from the nursery. The exhibitor recommends planting the *strobus* alone or mixed with the chestnut.

The result of chestnut-coppice, with a short rotation of five years, was shown; grape-stakes of chestnut, round and split; chestnut telegraph-poles, seventeen years old. The chestnut highwood becomes profitable in seventy years, and when cut it springs again rapidly from the stump, and the quality of the next crop is superior to the first.

The following table gives the mean results of the reckoning of a chestnut-forest:

Age of the trees in years.	Average product, in klafter.*	Mean growth in height for each decade in klafter.	Mean growth in diameter for each decade in cubic feet.
20	12	.....	60
30	20	0.8	66
40	28	0.8	70
50	36	1.45	72
60	48	1.45	80
70	65	1.45	93

* The normal klafter contains 100 cubic feet solid contents.

Herr Dimitz well says, as a summary on the chestnut, that its especial adaptation to the coppice of short rotation, to the *Mittelwald* and to the *Hochwald*, its easy reproduction by sprouting, its value as lumber, and the excellence of its nuts, all entitle it to a greater degree of attention from the forester of Southern Austria than it now receives.

22. ACKERBAU-MINISTERIUM.—In the north zone, near the eastern end of the Industrial Palace, there was a complex building erected by the Imperial Department of Agriculture, which, with a large space outside, was prepared especially for the exposition of the products of agricultnre, the forests and mines and salines, of Austria, which are nnder the charge of the very able minister, Herr Ritter von Chlumecky. To many visitors this was an exceedingly interesting part of the exposition, and was familiarly known as the "*Ackerbau-Ministerium.*"

The pavilion was quite large and roomy, though very full. It was plainly but strongly built, to sustain the great weight that was put into it. The ornamental was not needed where every square yard of space was occupied by objects of the deepest interest, tastefully arranged, and some of them also of intrinsic beauty. Externally, the pavilion presented rather an attractive appearance, due to some simple architectural ornamentations; but these were lost sight of by those who could appreciate the tasteful arrangement of the articles exhibited in the open air aronnd it.

On one side was an elevation made of rocks and soil, and supplied with water, on which were growing numerous alpine plants.

In another place were great masses of the limestone rocks of the southern portion of the empire lying near the Adriatic Sea; the region which, in past centnries, had been stripped of its timber to supply the wants of Italy to snch an extent as to become a barren waste. This is now known as the Karst, or the Küstenland.

The efforts recently made, and making, to restore its fertility by reforesting it will be noticed in another part of this report, and are now only referred to on account of the exhibit made by those who have the matter in charge. Among these bare rocks were growing young trees, of the several species reared in nnrseries, to the amount of millions, and already planted to a very large extent among the bare rocks of that desolated region.

The following young plants were growing on the rocks from Istria to illustrate the means of reforesting the desolate regions of that part of the empire:

Pinus austriaca, *Pinus maritima*, *Robinia pseudo-acacia*, *Fraxinus excelsior*, *F. ornus*, *Catalpa syringæfolia*, *Amygdalus communis* and *persica*, *Pinus sylvestris*, *Abies excelsa*, *Larix europæa*, *Pinus pinea*, *Acer pseudoplatanus*, *Acer negundo*, *Ostrya vulgaris*, *Æsculus hippocastanum*, *Tilia grandifolia*, *Ulmus campestris*, *Gleditschia triacanthus*, *Ailanthus glandulosa*, *Hibiscus syriacus*, *Melia azedarach*, *Maclura aurantiaca*, *Pyrus malus* and *communis*, *Prunus avium* and *mahaleb*, *Juglans regia*, *Castanea vesca*, *Morus alba*.

To prevent confusion, the articles will be taken up in groups, according to the several countries or provinces in which the state-forests are situated, following the catalogue, in which copious notes were made as they were examined.

23. BOHEMIA.—*From the Joachimsthal forest.*—In the pavilion were full descriptions and charts, with tables of resultant products and prices for a period of years. Outside were grouped the great logs, timbers, and other preparations of lumber, some of which are worthy of note.

Logs.	Age.	Diameter.	Length.	Contents.
	Years.	*Meters.*	*Meters.*	*Cub. meters.*
Spruce	140	0.84	34.00	7.15
Do	125	0.79	33.50	5.83
Do	138	0.71	30.30	3.47
Do	116	0.36	17.00	1.033
Do	116	0.275	15.00	0.349
Do	70	0.47	33.50	2.49

Then came the lumber of very fine quality, as timbers, boards, posts, shingles, &c., and a collection of tan-bark from the spruce-trees.

From Schönberg, in the northern part of Moravia, near the southern base of the Riesegebirge, was a collection of forest-products, including plants from the high mountains, sent by the Forest Association; also sections of logs of different kinds taken from the highest, the middle, and the lowest altitudes, to show the relative wood-growth; these were spruce, fir, maple, and elm; mosses from the heights of the snowy mountains; resonance or sounding boards, made from two hundred and fifty year old spruce that grew 4,100 feet above the sea; a miniature model of a charcoal-establishment; beech-staves, felloes for wheels, spunk, and articles prepared therefrom.

24. BUKOWINA.—In the pavilion, models of ship-masts, yards, and timbers; models of wagons; shovels, trays, and bowls of maple-wood and beech; staves; resonance-boards; shingles from fir; spruce tan-bark; crude potash; crude tar and seeds; spunk from the beech; a collection of insects by the forester Schirl in Zuczka.

Among the timbers outside were some very fine masts and yards, some of great length; and logs.

	Age.	Diameter.	Length.	Contents.	Elevation.
	Years.	*Centimeters.*	*Meters.*	*Cub. meters.*	*Meters.*
A. Fir	250	105	53.	37.7	800
Spruce	210	76	53.	16.64	800
Beech	120	68	11.3	4.2	150
Oak	160	78	18.9	9.31	150
Oak	120	73	17.	3.63	125
Sorbus torminalis	60	36	10.9	1.2	250
Acer pseudo-platanus	100	52	11.3	3.31	125
Ash	315	95	30.3	12.06	1,140
Maple	280	87	18.9	4.98	950
Beech	280	63	20.8	5.11	250
Hornbeam	130	50	11.3	2.52	250
Maple	190	68	11.3	5.4	250
Linden	150	94	11.3	9.6	250
Alder	130	47	13.2	2.35	100
Fir	182	81	53.	11.68	950
Aspen	65	37	8.5	1.26	130

25. GALLICA.—*Statistical description and charts.*—A model of a long raft, with all its appurtenances; model of a mountain saw-mill, with circular and gang saws; model of a colliery; model of a galley made from sprnce, such as carry from 800 to 1,000 hundred-weight to Odessa; models of ox wagons and sleds; various wooden articles for domestic use, very fine; resonance-boards; and many fine preparations of wood for various purposes, shingles, &c. Forest-tools of all kinds, for felling, cutting, splitting, shaving, and coaling-tools.

Outside were abnormal growths of pine, oak, elm, birch, showing very curious irregularities, and some starved trees of considerable age, but little height, and very small diameter. Other logs, of great beauty of form and of good size, give a much better idea of the Galician forests. An exhibit of the durability of wood under certain circumstances was made from the salines of Wieliczka; a stick 3 feet long by 18 inches, since 1695; one 3 feet long by 18 inches, set in the year 1600; one 7 feet long, salt-incrusted, set in the year 1636; one 3 feet 6 inches by 18 inches, set in the year 1696; a pine stick hewed in the fourteenth century; an aspen-stick set in the sixteenth century. These were all taken from the mines, where they had been exposed to moisture and pressure.

26. GÖRITZ AND ISTRIA.—Chorographic charts, production-tables, and maps representing the several portions of the imperial estates in these countries that we call Illyria.

In the pavilion was a model of charcoal-ovens, such as are used in Ternova, where they have no water to control the fire. A very extensive collection of woods in book-form, showing the rate of growth, the specific gravity, and the elevation on which they grew, to the number of one hundred and fourteen kinds, all classified according to de Candolle. The common and botanical names of this interesting collection were also given, with the place where they grew, prepared by Forstmeister Redl.

A very extensive and elegantly-prepared collection of beetles injurious to the forests, amounting to two hundred and sixty-four species, by Oberförster Franz Miklitz; and a small group of six species of beneficial insects. These are grouped according to the injury they effect: eleven are destructive to the young trees in the nursery and seed-beds; one hundred and sixty-eight do their work of destruction in the standing forest; and one hundred and seven consume the fallen wood and lumber.

These insects were collected in various provinces: all of which places are indicated by different colored cards attached to the insect-pins.

Outside was a collection of wood, sections of logs, with the several particulars given in the annexed table.

Species.	Exposure and soil.	Above sea.	Specific gravity.	Age.	Height.	Diameter.
		Meters.		*Years.*	*Meters.*	*Cubic meters.*
Fir	Sheltered, humose	1,000	0.4549	74	30	39
Fir	Sheltered, stony and shallow	1,000	0.5282	80	28	31
Fir	Northeast exposed, poor	906	0.5541	84	10	16
Fir	Southwest sheltered, humose	906	0.4501	84	24	56
Fir	Northeast exposed to the northers, poor	1,230	0.6482	85	12	14
Fir	Sheltered, humose	1,090	0.5369	125	37	73
Fir	Northeast exposed, stony	1,290	0.5943	150	12	21
Fir	Northeast exposed, stony	1,330	0.4918	150	10	13
Spruce	Sheltered, deep and sandy loam	1,100	0.4497	77	25	50
Spruce	Northeast exposed and stony	1,330	0.6128	136	13	14
Spruce	Sheltered, deep sandy loam	1,100	0.5327	140	19	40
Spruce	Sheltered, humose	1,250	0.5436	147	25	60
Beech	Sheltered, humose	1,000	0.8528	125	33	56
Beech	Northeast exposed to northers, poor soil	1,000	0.7355	170	9	11
Beech	Sheltered, humose	1,000	0.9589	145	33	50
Beech	Sheltered, stony, poor	1,000	0.9487	145	17	31
Beech	Northeast exposed to northers, stony, poor.	1,290	0.8575	174	16	32
Beech	Southerly sheltered, good soil	1,300	0.9351	190	23	41
Beech	Northeast hardest northers, poor soil	1,200	0.7019	190	12	18
Beech	Sheltered, rich in humus	1,050	0.8356	192	29	45
Sorbus aria	Northers, poor	1,200	0.9380	150	9	21
Q. pedunculata	Sheltered, sandy loam	100	1.0084	110	24	50
Austrian pine	Somewhat exposed to northers, humose	100	0.6710	56	14	44
Q. pubescens	Somewhat exposed to northers, thin	150	1.2310	35	8	26
Q. pubescens	Sheltered, humose, chalk	100	1.1051	35	8	21
Cork-oak	Sheltered, humose, Karst soil	33	0.9523	40	8	20

Collection of woods, split pieces.

Name of tree.	Soil and situation.	Elevation.	Specific gravity.
		Meters.	
Oak, Quercus pedunculata	Sheltered, sandy loam	100	1.0084
Oak, Quercus pedunculata	Sheltered, wet land	15	0.9943
Quercus pubescens	Sheltered, stony, hut humose, chalky soil	120	1.1226
Spruce	Sheltered, stony, humose, chalky soil	1,250	0.5446
Fir	Sheltered, stony, humose, chalky soil	1,015	0.5283
Larch	Sheltered, humose sandstone	490	0.6694
Beech	Sheltered, humose, chalky	880	0.9009
Sorbus aria	Sheltered, humose, chalky	996	0.8903
Austrian pine	Rather exposed, humose sandstone	100	0.6710
Cork-elm	Sheltered, humose, wet soil	15	0.8616
Acer pseudo-platanus	Sheltered, stony, humose, chalky soil	1,015	0.8545

Here are some sections of logs of remarkable dimensions, from the Ternova forest, at an elevation of 1,000 meters:

Height of tree.	Length of log.	Diameter, breast-high.	Diameter, small end.	Cubic contents.	*Formzahl.*
Meters.	*Meters.*	*Meters.*	*Festmeters.*	*Festmeters.*	*Festmeters.*
41.15	22.15	1,765	0.737	30.336	0.32
41.00	20.55	1,264	0.758	21.140	0.41
39.50	15.12	1,238	0.800	16.400	0.36
40.44	16.74	1,238	0.822	17.854	0.40
39.81	16.46	1,212	0.798	17.000	0.37
40.76	20.22	1,238	0.764	21.582	0.44

A collection of timbers prepared for ship-building, knees, keels, beams &c., and the model of a ship.

Young plants from the nurseries, ready for planting in the Karst-lands.

A collection of ship-builders' tools.

These specimens from the existing forests of this region prove the adaptability of the soil and climate for the production of this staple,

and furnish great encouragement to those who have wisely undertaken to reproduce the sylvan garniture of the extensive wastes of the Küstenland.

27. CARINTHIA.—In the pavilion, we find the usual charts and tables, and also photographic representations of interesting portions of the forests; models in relief of the valley of the Drave; and specimens of prepared wood in various forms.

Outside was a collection of logs of different kinds, from various elevations, with their several dimensions and contents, age, specific gravity, &c.; some of these grew at an elevation of 1,600 meters; prepared lumber and materials.

28. CARNIOLA.—In the pavilion were models of log-ways, and waterways for transport, with their reservoirs of supply; photographic illustrations of the works; forest-charts dating back to 1760; tools for forest-culture; tools for felling and preparing the timbers, and for moving and handling them; apparatus and tools for making the ways and roads in the forests.

Outside was a collection of logs and timbers, some of the former of great size and showing by the annual rings a remarkable growth; a beech two hundred and fifty-eight years old that grew at an elevation of 950 meters was 55 centimeters in diameter at breast-high, 34.12 meters long, with 14.50 cubic meters contents; a chestnut sixty years old, at an elevation of 570 meters, diameter at breast-high 32 centimeters, length 22.75 meters, contents 1.06 cubic meters.

The chestnut grows rapidly and is very durable, and the stem remains sound until seventy years old. It is used for grape-stakes, staves for wine-casks, and other purposes. For grape-stakes, it may be cut when five and six years old, and it makes telegraph-poles in seventeen years.

There was a remarkable stump of fir, which had sprouted after having been cut, and another that had grown so as to heal over completely; specimens showing the serious injury inflicted upon trees by pasturing.

29. LOWER AUSTRIA.—In this region, the Wienerwald, so near at hand and so well known by the curious, furnished a large collection.

In the pavilion were numerous charts, maps, and relief-models of various parts of the forests, representing the surface, the water-ways, the roads, and the kinds of trees.

Tools used in felling and preparing the wood and in transporting it; also the apparatus employed in the gathering of the pitch from those portions devoted to the Austrian pine.

Outside were sections of various kinds of trees, and logs of handsome appearance and good size; their age, height, thickness, and contents were given with each.

The Austrian pines that had been felled for the tar were also shown in different stages of the process.

Various preparations of wood for use in the arts, especially for the wagon-maker.

Many abnormal growths were exhibited that were exceedingly curious and interesting.

30. UPPER AUSTRIA.—*Salzkammergut.*—In the pavilion were a collection of all kinds of forest-tools. Resonance boards of spruce; the annual production amounts to 2,500 cubic meters. A cubic meter was worth about $12 at the stump, and when worked up it was worth $163.

Models of log-ways used in that region, and of water-ways with their reservoirs, maps of the several forests, and relief-charts.

Outside was a collection of logs, showing the character of growth in that region.

31. DUCHY OF SALZBURG.—In the pavilion, maps, statistic tables, plans, and model; a complete set of forest-tools, &c.

The following table shows the injurious effects of grazing in the woods, which, on account of the servitudes, is still practiced to some extent.

	Elevation.	Situation and soil.	Age.	Height.	Average diameter.	Contents.
	Meters.		*Years.*	*Meters.*	*Meters.*	*Cubic meters.*
1	1,300	Northern slope; rather humose soil, on chalk	30	12.5	0.053	0.056
2	1,300	do	25	4.4	0.039	0.009
3	1,200	do	53	16.7	0.158	0.327
4	1,200	do	53	13.9	0.079	0.069
5	1,070	From a north slope; on a strong soil on mica-schist	43	8.8	0.092	0.058
6	1,170	Southeast slope; stony, rather strong soil	70	18.9	0.197	0.581
*7	1,170	do	80	25.9	0.263	1.405
8	1,170	do	90	17.0	0.158	0.334
9	1,170	do	90	14.8	0.118	0.164
10	1,050	North slope; loam and lime	95	12.9	0.131	0.176

*Normal.

Contrast the second with the third, the fourth with the sixth and seventh, as to their relative contents.

32. ILLUSTRATIONS OF THE DURABILITY OF TIMBERS IN THE SALT-WORKS.—A piece of spruce which had stood twenty-five years in a dry place under great pressure, 190 meters deep; a cross-beam of spruce, which had borne a severe vertical pressure fifty years in a damp place at the same depth; another under similar circumstances for one hundred years, and a piece of flood-gate from one of the oldest establishments, from two to three hundred years old; logs of stone-pine of different ages up to two hundred and sixty years, grown in elevated places from 1,430 to 1,850 meters above the sea, and other kinds of logs; larch cut into cross-ties, usually 6 by 5 inches. The tree was five hundred and thirty years old; diameter, breast-high, 86 centimeters; 25.43 meters long; contents, 6.75 cubic meters.

Tree.	Elevation.	Age.	Diameter.	Length.	Contents.
	Meters.	*Years.*	*Centimeters.*	*Meters.*	*Cubic meters.*
Larch	1,580	575	82	16.5	4.93
Spruce	1,250	290	105	38.40	8.72
Fir	900	335	119	19.	11.94

33. STYRIA sent models of reservoirs and water-ways, of shelter-huts, of ice-ways, sleds, and collieries; also tools of all kinds for preparing wood and timber, and for coaling.

34. TYROL AND VORARLBERG.—In the pavilion were tools and apparatus for cutting and transporting lumber; models of reservoirs and water-ways of collieries; statistic tables, and an album of the views of constructions and interesting objects connected with the land and water transport.

These representations of the modes of overcoming difficulties incident to an alpine forest-region could not fail to attract attention.

Outside was a collection of logs and timbers; among them some fine sticks of Scotch pine and spruce cross-ties, and logs for masts and spars; abnormal growths of several kinds.

35. DALMATIA.—In the pavilion, sections of different woods, especially of southern kinds, unknown to the forests of other parts of the empire.

36. STYRIA.—The collective exhibition from Styria was another of the exceedingly interesting groups of forest-products. It was placed in and around a neat building erected for the purpose, with open sheds on either hand for the coarser products. In the front, outside, were groups of forest-plants of many kinds; among them spruce, pines, and larches from the seed-bed and nursery, where they are prepared for planting in the high mountains. These are preferred when from three to five years old, as then they can better withstand the growth of grass to which they are exposed. Ash, maples, and firs were also present. These contributions were from the Vordernberg Company; Baron Sessler-Herzinger, from the Leoben Society; and the Stock Company of the Innerberg Establishment.

Forest-culture in the high mountains of Styria, which is situated from 1,400 feet to 4,500 feet above the sea, is quite a difficult matter. Notwithstanding the excellence of the soil, the scarcity of suitable labor, the shortness of the period of growth, the unfavorable influence of the climate and atmosphere, and the practice of pasturing requires for success the application of pecuniary sacrifice, great assidnity, and patience. This culture began to attract attention about twenty years ago. In many clearings, the method of Beerman and Butler was applied. In the highest places, the tuft-planting* was tried, and planting in the usual way where, from the character of the soil, every intricate method of great cost was excluded. The country people, who occupy the greatest area, are enemies of forest-culture; to them pasturage offers a higher profit. The culture costs from 3 to 8 florins per joch in the higher places, and in the worst soils, (*verfitzeen*,) from 5 to 15 florins.† Culture, be it understood, consists in planting the trees, and does not imply what we should consider cultivation afterward. With the European forester, a

* *Buschelpflanzung*. planting in bunches.

† We may read this, 40 cents to $3 per acre, and $1.90 to $5.50 per acre.

cultivated forest is one artificially stocked, and not the natural growth. More recently attempts are made to mix the species in these plantations, since in the Styrian mountains the deciduous trees are generally wanting and frequently desired.

Logs.—From the Innerberg Company, there were some fine logs; a spruce 16 klafter (96 feet) long by 32 inches thick; a larch of the same length and 30 inches thick; and a fir of similar length, by 42 inches in diameter; beautiful and remarkable shafts they were. These trees were felled on the boundary of Styria with Upper Austria, brought to the river Enns without the aid of machinery, and floated by it and the Danube to Vienna.

There was a spruce log 51 inches diameter, from Vordernberg, which grew at the height of 5,400 feet on gneiss, and in an open situation. This remarkable log was 118 feet long, but in falling it broke into three pieces. It was taken to the railroad by means of sleds.

From the Vordernberg Society was a fir-log, 72 feet long by 32 inches diameter; one of larch, 60 feet by 34 inches; and others very fine. Here were also to be seen logs of yew and of the Swiss stone-pine (*pinus cembra*) from the elevated alpine regions; also some spruce and larch poles for high building, remarkable for their length and strength.

The export of long timber has recently assumed a remarkable importance in Styria. It is carried on by rafting, chiefly on the Mur, the Enns, and the Traun Rivers. The spruce and firs go to Vienna and Gratz; the larch, for ship-timbers and for masts and spars, to Triest, Venice, &c. Great quantities of props for the mines are taken to the mining-regions of Upper Austria.

The first transport of the long timbers from the mountains is effected chiefly by hand, aided by artificial slides and ways. The carriage of the smaller pieces is tedious and laborious in the mountains, and necessarily expensive.

In the sheds which were erected, on either end of the pavilion, were collections of prepared woods, split, hewed, and sawn, chiefly of spruce, fir, and larch. Among them were cross-ties sawn in peculiar form, so as to economize the timber. Some were cut 6 by 8 by 10 inches, and intended to rest upon the broadest side; here were also squared timbers.

From Graf von Luchesi were oak posts, boards of elm, maple, linden, birch, alder, walnut, and ash, of unusual dimensions, intended for the cabinet-makers and were remarkable for their texture and perfection; finely-split material for the Triest market, and for various purposes.

From Vordernberg were boards of the stone-pine of extraordinary dimensions, planed and polished for furniture and for carving, for which they are well adapted, because of the firmness of the fibers; on this account, they excel all other lumber. Such trees grow only on the highest mountains, near the timber-line. This species grows also in lower situations, but it prefers the summits.

Graf Luchesi showed oak staves and other split oak-wood of remarkably fine texture; grape-stakes elegantly split and dressed, made from spruce and also from our favorite black locust; the latter was produced in the lower forest-lands.

Baron Sessler-Herzinger had grape-stakes made from larch, which were very good; also shingles made from larch. These were of remarkable size, and made without the usual groove, common to the European shingle, by which they are joined laterally on the roof. These larch shingles are sought for on account of their greater durability and their resistance of the influence of the weather.

From the Hohenwanger Company were charcoals from spruce and fir, and sections of larch and spruce intended to show the growth of wood in various places in the high mountains.

A very important industry in Upper Styria is coaling for the use of the iron-manufacture, especially as there is no stone-coal. The two great smelting-establishments at Eisenerz and at Hieflau, belonging to the Innerberg Stock Company, and that at Vordernberg, have used 21,000,000 cubic feet of charcoal in a year, two-thirds of which they make, and one-third is purchased. Besides these, the scythe-works, the steel-works, and machine-works consume great quantities. So important an interest is this that the Vordernberg Company exhibited a table of the production, in cylindrical form, of the coal from a given quantity of wood of different kinds, that had been cut from one to three years. The measure and weight of the wood are given, then the amount of the coal, and lastly the percentage in measure and weight of the result.

In traveling among these collieries, there seemed to be nothing like our charcoal-ovens, nor was there seen at the exposition any model of such a contrivance. Great care and skill are exercised in putting up the kilns; but they are all conducted upon the primitive plan of piling the wood, and covering with earth to control the fire.

Another admirable illustration of the care with which the coaling of wood is studied consisted in a group of thirty-three cubes of definite size, beside which were placed the resultant cubes of charcoal produced by burning similar blocks. This was illustrated by a table, showing the name of the wood, the part of the tree, whether stem, stump, or branch, the size, the relative weight of a cubic meter of wood and coal; next, how much coal is produced by a cubic meter of wood, and the percentage; next, the percentage of loss in measure and weight. These thirty-three cubes represented as many different kinds of wood. The experiments were made by the Innerberg Mining Company, and the tables enable them to make very close calculations on their results in coal-burning.

The same association also presented another valuable table, with illustrations in wood, showing every important element connected with the results of the process of coaling; giving the name of the tree, station as to elevation, place, direction of exposure, sheltered or otherwise, the rocks subjacent, character of soil, &c.; then the age, height,

strength, amount per hectare; the ascertained measure of the trunk, stump, and branch in cubic meters; the last year's height, strength, and mass, and the entire contents in cubic meters; then the successive growths in periods of twenty-five years up to two hundred and twenty-five years. There were twenty-five of these representations.

Among the curious and interesting things which attracted the attention of strangers were articles of dress; the green felt hats and the green velvet and fustian or velveteen jackets with showy buttons innumerable; the short breeches of buckskin, with knee-buckles, not quite reaching the long green woolen stockings and the heavy shoes armed with iron points to keep them from slipping on the ice or smooth rocks. Thus equipped, the mountaineer still needs his *Alpenstock* when taking an excursion, with his fowling-piece slung over his shoulder, and a good field-glass suspended from his neck.

In this beautiful room, there were many objects of interest. The walls were ornamented with photographs of some of the establishments for mountain-industry, of the mountains themselves, and of some of the most picturesque *Thäler*, or valleys, and ravines, some of which, deep and narrow, nearly closed in by the almost vertical rocks, resemble the wild cañons of the Rocky Mountains of our own country.

A group of rocks covered with alpine plants occupied one side of the room, and here were placed the fauna of the Styrian Alps, elegantly prepared and tastefully arranged by the Rev. H. Blasius, of Mariahof, near Neumarkt.

The Emperor has a fine hunting-lodge in the wild Thal Radmer, and here were also some of the trophies of the chase, taken by himself and by the young crown-prince Rudolf. Graf von Meran also had a large collection of horns of deer and chamois, trophies of the chase in these mountains, as had several other exhibitors, for the Styrians are all mountaineers and hunters; those who do not sport the horns or foot of a chamois will have at least the flower of the *Edelweis* in their hat-band or button-hole as a trophy from their alpine heights.

37. HUNGARY.—The extensive and very rich exhibition made from the forests of Hungary required the erection of special and commodious apartments. The main forest-pavilion was erected in the form of a wooden church, such as embellish the Eastern Carpathians among the inhabitants of Svathmar and Marmaros. This illustrated the peculiar Hungarian architecture, and was quite oriental in its style. The positions for wood-industry were a little to the south of the main building, and a large area on all sides was occupied by immense logs, normal and abnormal growths, and the coarser kinds of prepared lumber, both split and sawed. This immense exhibition, in the collection, transporting, and exhibition of which the government expended about $100,000, represented the forest-products of the Hungarian countries, including the provinces of Croatia and Slavonia; the articles exhibited were drawn from the government forests and also from private estates.

Besides this great group, there are some very rich collections, such as those from Archduke Albrecht, from the Duke of Coburg, from the Austrian Railway Company, and others, which occupied separate pavilions, or were placed in the agricultural halls; these will be treated separately.

In such a grand collection as was here presented, it will be impossible to particularize, as the details would occupy too much space. Among the various objects of such deep interest, however, a few must be brought into this report.

The primary products of the forests, such as bark, wood, sawed and and split, were presented in great abundance from all parts of the kingdom of Hungary. The tools used in felling, transporting, and preparing the lumber; models and plans for transport, in their minutest details, were exhibited. Abnormal and diseased growths were contrasted with healthy products. Here were the results of experiments on the strength of material, accompanied by a pamphlet,* showing the effects of numerous trials in this important branch of physical investigations.

Charts, plans, and statistic tables, showing the condition of the forests, their cost and returns, and propositions for their improvement, were numerous upon the walls. Everything of this kind that could thus be addressed to the eye was here presented; as were herbaria, showing not only the forest-botany in the usual way by a collection of the plants, but also similar plants, particularly young forest-species, grown on various soils, exhibiting the different character of the roots produced in each.

Among these last, some of the most remarkable were little tree-plants, with their roots, that had been brought from the region of blowing sands of the Lower Danube; these show remarkable growth of tops and roots. They consist of pines and other trees; notably of our own invaluable black locust, (*Robinia pseudo-acacia.*)

Numerous collections of wooden blocks were sent by various contributors. These are generally of uniform size in each group, and are elegantly prepared; one or more sides polished so as to bring out the grain and characters of the wood. Some of these are made to resemble books, and are named on the part corresponding to the back of the volumes. A favorite product appears to be thin layers, like veneers, which are marked as articles to be used by shoemakers and book-binders. They are so thin that it requires sixty thicknesses to make an inch, and in one sample sixty layers measured only three quarters of an inch in thickness; this is like our wooden wall-paper, but is not used for that purpose.

Seeds of forest-trees were very extensively exhibited from various parts of the country; and oak-bark, very nicely peeled and prepared in rolls, or quills; this is taken from young trees. The copse is cut over every fifteen to twenty-five years, and allowed to spring up again for another crop.

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* *Untersuchung über die Festigkeit der Hölzer: Jos. Vessely, Domäne-Inspector.*

Mr. Franz Schmitt had prepared a pamphlet,* in which the whole process is described; and the subject may become one of importance to us whenever the now abundant supplies of rock-chestnut oak of the Alleghanies shall have been destroyed. The young trees (copse) of this species grow very rapidly.

In the wood-industry pavilions were innumerable articles of wooden ware of various kinds, from cross-ties to barrel and hogshead staves, of the finest quality. These last were of dimensions to make the largest sized casks, such as were shown, great tuns, to rival that which has rendered Heidelberg famous. One of these great casks would hold 2,500 eimer, an Austrian measure of nearly 9⅓ gallons; so that its contents, in our measure, would be 23,325 gallons. This cask is made of 71 staves, each 21½ feet long. At the end it measures 17 feet across, and in the middle 19½ feet. The staves are 7¼ inches thick; the head-pieces, 6½.

Among the preparations of wood that are associated with art were woods elegantly prepared for inlaying floors, (parquetry,) which are very much used in Europe; sounding-boards (*Resonanz-Hölzer*) for pianos; garden-furniture, rustic work made chiefly from the stems of hazel or filberts; narrow strips of thin stuff for making screens, (*jalousies*, as they are there called,) and much used in eastern architecture.

Outside these pavilions there was an extensive space, occupied by specimen logs from various sections of the country that were really remarkable. Some of these must be noticed, with their dimensions.

From the Carpathians were an ash log 44 inches thick, a Norway spruce 44 inches, an elm 36 inches, an oak 30 inches, a fir 48 inches. A larch log was 65 feet long, 6 and 15 inches thick; another was 50 feet long, 6 and 23 inches thick; a Scotch pine was 83½ feet long, 4 and 13 inches thick; another was 50 feet long, 15 and 20 inches thick; a beech 72½ feet long, 11 and 21 inches thick; an oak 60 feet long, 8 and 14 inches thick; a spruce 126 feet long, 48 inches at base; a fir 134 feet long, 13 and 58 inches diameter.

From Siebenbürgh was a spruce 148 feet long by 11 and 35 inches thick; sections of Scotch pine, 21 inches; of *Q. cerris*, 22 inches; of bird-cherry, 17 inches; of hornbeam, 13 inches thick.

From the Carpathians were sections 22 to 31 inches: alder, 22 inches; silver-fir, 43 inches; maple, 37 inches; beech, 40 inches; silver-fir, 45 inches; elm, 31 inches; spruce, 44 inches; elm, 30 inches; maple, 39 inches; birch, 16 inches; chestnut, 26 inches; walnut, 19 inches; bird-cherry, 16 inches; larch, 27 inches; Scotch pine, 28 inches; silver-fir, 34 inches, and Norway spruce 32 inches.

Of timbers handsomely dressed: Scotch pine, 48 feet long, squared 10 inches; a larch, 56 feet, squared 11 inches; a silver-fir of 60 feet, squared 13 inches; a Norway spruce, 60 feet, squared 12 inches; an oak, 60 feet, was squared 18 inches; another oak of 60 feet, 15 inches;

* *Die Gewinnung der Eichenlohe.*

a spruce 70 feet long was dressed to 18 by 32 inches. There was also in the same group a fine collection of logs from the famous forests of Croatia and Slavonia, whence great quantities of cooper's stuff are exported to all parts of Western Europe.

Logs.—Oak, (*Quercus pedunculata,*) 90 feet long, 14 and 42 inches diameter; oak, (*Q. sessiliflora,*) 69 feet long, 17 and 32 inches diameter; silver-fir, 133 feet long, 10 and 44 inches diameter; spruce, 133 feet long, 8 and 34 inches diameter; beech, 75 feet long, 17 and 39 inches diameter; maple, 58 feet long, 25 and 40 inches diameter; Austrian pine, 76 feet long, 7 and 20 inches diameter; Scotch pine, 89 feet long, 4 and 32 inches diameter; elm, 90 feet long, 15 and 30 inches diameter; ash, 88 feet long, 16 and 32 inches diameter. From the same forests were beautiful dressed timbers, the dimensions of some of which are here given: Norway spruce, 74 feet long, 11 by 33 inches; silver-fir, 81 feet long, 22 by 58 inches; maple, 47 feet long, 26 by 27 inches; hornbeam, 29 feet long, 26 by 37 inches; oak, (*Q. pedunculata,*) 91 feet long, 10 by 30 inches; elm, 84 feet long, 11 by 31 inches; ash, 84 feet long, 13 by 44 inches; Norway, 70 feet long, 30 inches square; fir, 70 feet long, 30 inches square; beech, 50 feet long, 18 inches square; Norway, 70 feet long, 20 inches square; fir, 70 feet long, 20 inches square; oak, (*Q. sessiliflora,*) 60 feet long, 16 inches square; Scotch pine, 45 feet long, 11 inches square; Scotch pine, 64 feet long, 10 and 17½ inches square; Austrian pine, 66 feet long, 9 and 15 inches square; oak, 60 feet long, 15 inches square; oak, 63 feet long, 16 and 51 inches square; elm, 75 feet long, 11 and 30 inches square; ash, 74 feet long, 10 and 33 inches square; linden, 30 feet long, 10 and 17 inches square; alder, 30 feet long, 8 and 15 inches square.

There was also a group of sections of logs, from places whence, on account of the extreme mildness of the winter of 1872–'73, it was impossible to transport great logs over the roads. Among them were the following: oak, (*Q. pedunculata,*) 53 inches diameter; oak, (*Q. pedunculata,*) 65 inches diameter; oak, (*Q. sessiliflora,*) 42 inches diameter; chestnut, 47 inches; beech, 46 inches; ash, 43 inches; ash, 36 inches; elm, 62 inches; elm, 38 inches; elm, 56 inches; hornbeam, 32 inches; maple, 40 inches; linden, 34 inches; silver-fir, 54 inches; silver-fir, 60 inches; Norway spruce, 43 inches; another, 52 inches; Austrian pine, 22 inches; and a pine, 28 inches.

Mr. Zellen, of Galetten, showed bast from the mulberry-tree.

Bachmeyer & Co., of Temesver, had various forest-products.

The Countess Anthonia Bathyanyi, of Élesd, exhibited a fine log from her estate.

Mr. John Bibel, of Orawitza, had a collection of staves for barrels.

From Baron Bornemizza, of Maros-Illye, Transylvania, was a group of forest-products.

From the Dominion of Bakotra was exhibited, by the Baranyaer Company, barrel-staves and beech-felloes.

From the forest-office of Bellovár were some boards.

Mr. Copony, of Rosenau, exhibited some logs.

William Dapsy, of Rima-Szombat, showed gall-nuts.

From the domain of Diakovar, in Slavonia, were some forest-products.

Eugene Dvihálly, forester, Huszt, showed a table and settle of mahaleb-cherry and cherry-wood.

Count Erdody, of Marcovecz, had a linden log on exhibition.

John Erlitz, of Zirtz, had a collection of spunk.

Count Paul Esterházy, of Ugod, exhibited forest-products.

Anton Freistadter, of Kaposvar, and Albert Fekker, Royal Head-Forestmaster at Abrudbánya, showed collections of similar articles.

The Hungarian department of finance at Ofen exhibited their forest-products.

The chamber of trade of Fiume had a collection of woods from Hungary.

The chapter of Gran, at Szobb, exhibited a group of forest-products.

Oberförster Julius Grachey, of Gros-Kanizsa, made a similar display.

Pitomaca Gyurgyevics, of Bellovár, forest-products.

Geo. Hoffmann, of Weidenthal, showed beech-spunk.

Adolf Ludwig Hessheimer, of Kronstadt, and F. W. Hoffmann and Ignacz Hartl, of Essegg, exhibited various forest-products.

Christian Herrmann, stave-dealer in Vienna, showed woods from Hungary.

John Horváth, of Kronstadt, had a very interesting collection of hats and caps made of spunk.

Adolf Moritz Kanitz, of Pesth, had forest-products and gall-nuts.

Count Alois Karolyi, of Erdöd, showed building-timbers and boards.

Count Albert Keglevich, of Bodoka-Toma, had woods, boards, and shingles.

Graf Guido Karacsonyi, of Bodra in Bánlak, showed transverse sections of wood and seeds of trees.

Graf Gustav Königsegg, of Pruszkau, had a plan for forest-improvement.

C. A. Kraetschmar, of Rima-Szombat, showed galls and acorns.

George Kueres, of Zeiden, exhibited veneers.

The Agricultural Society of Bistriz showed a group of cross-sections of wood.

The Agricultural School of Debreczin presented "Studies on the Robinia," with graphical delineation, tables of production, and sections of the wood.

The Agricultural School at Keszthely exhibited articles from the forests.

Michael Loewe, of Csácza, showed pitch from the spruce-tree.

I. C. Ritter & Co., of Szlatina; L. Neuwirth & Co., of Essegg; and Leopold Ritter von Popper exhibited forest-products.

Joseph Pfeiffer, of Vienna, showed forest-products from Slavonia.

The Agricultural Society of Pressburg had a collective exhibition.

Baron Bela Piret showed products from the domain of Drós-Jenöer.

George Ratz, of Debreczin, had galls and tan-bark.

John Reitzner, of Kaschau, and M. Roth, of Kronstadt, showed yew-wood.

Franz Schnitt, of the Administration at Szokola-Hutta, Count Ervin Schönborn, of Munkács, and Nicholas Alexander Schulz, of George's Garden near Rába-Hidvég, exhibited forest-products.

Baron Simon Sina showed the products of his forests at Baan and Teplicska, and from Simongät he had galls, deciduous and evergreen plants, and logs.

Ch. Wallfisch & Sons, at Arad, showed various woods.

Count Albert Zay, of Zay-Ugrócz, had oak-bark.

Alexander Gliederer, of Sissek, and Gilbert Pierre, of Rečica, exhibited barrel-staves.

From the parish of Dubrava an oak log was brought.

Joseph Schmidinger, of Warasdin, exhibited samples of maple and red yew, bushes of ivy, and larch-plants.

August Duke of Saxe-Coburg-Gotha made a grand exhibit of the productions of his forests at Belegvár, Csepreg, Kapsdorf, &c., in a separate and beautiful pavilion.

38. ROUMANIA.—From her broad area of fifteen millions hectares, of which about eight millions are in forest, there was quite an extensive collection of woods, but they were not remarkable except as showing the kinds of forest-trees produced, as Norway spruce, silver-fir, oaks, ash, cherry, beech, birch, elms, poplar, walnut, mulberry, holm-oak, yew, dogwood, hornbeam, maple, pear, serviceberry, thorn, hazel, linden, alder, &c. These were shown in logs, boards, timbers, shingles, and also as blocks.

39. TURKEY, among 2,696 entries, had fifty or more of forest-products. Among these were very extensive collections, embracing hundreds of elegantly-prepared blocks, some of which were marked with Arabic characters, but none of them so named as to be intelligible to us. Others exhibited acorns, bark of different kinds, but especially gall-nuts, dyes and dye-stuffs, and spunk.

40. GREECE.—Theodore Orphanides, of Attica, had a collection of woods artistically and very elegantly prepared, showing the form, the bark, rough-cut wood, and polished, and also the botanical characters. The Public Nursery in Attica had an extensive illustration of forest-trees and ornamentals; specimens of ramie and other valuable plants. This was a good nursery exhibition or advertisement.

41. PERSIA.—From this ancient land, we have had such sad accounts of famines, resulting from the destruction and present scarcity of forests, notwithstanding the oft-quoted maxim of its own wise philosopher, Zoroaster, that we had not expected an exhibition. We had at Vienna, however, evidence that there are still trees in Persia in the interesting show of their products.

Despite the scarcity of trees in the table-lands, the plane-tree, which is especially trained by the people, makes a high stem, and furnishes valuable lumber. Two different species of ash and the *Prunus mahaleb* yield beautiful wood for veneers.

The trunks of the *Amygdalus orientalis* are much esteemed for their straight growth, for their strength, and for their silvery-white color.

On the lowlands of the Caspian Sea, and on the slopes of the *Elbarg* Mountains, are found beautiful oaks, especially the *Quercus castancifolia*, the cypress, varieties of maple, the walnut, box, beech, gleditschias, and mimosas; so that Persia has a sylva of value and importance.

Numerous examples of these woods were shown by the minister of agriculture, Hassan Chou Geras, in the name of the Persian empire; of these, few had the botanical names; but the oak, walnut, maple, ailantus, alder, lemon and orange, cypress, pine, plane-tree, and others could be identified; seeds of the cypress and of the *Melia azedarach*, also acorns of the *Quercus vallonii*, which are sweet, and, when roasted, are used for making bread. The same species furnishes useful wood as well as galls and tan-bark.

42. SIAM furnished its quota by presenting specimens of teak and other woods in considerable numbers, but unknown by their native names.

43. CHINA showed a small collection of woods, but without any indications as to their names or qualities.

44. BRITISH COLONIES.—CEYLON.—From the forests of this island were specimens of cinnamon, the bark of the *Laurus cinnamomum;* also cinchona-bark by Mr. Layard, who exhibited, besides, quite a collection of tropical woods, most noted for their value in building, for cabinet-ware, and other construction; all shown with their botanic names.

45. MAURITIUS.—This gem of the Indian Ocean furnished an exceedingly rich collection of fibers and woods, mostly native. Of these, there were sixty-two kinds, presented with their botanical names, shown by Mr. J. Horne, of the Botanic Gardens; by the same exhibitor, descriptions of these woods, their qualities and uses, and the characters of the trees which produce them.

46. BRITISH INDIA.—From the rich forests of this country, which are now better managed than heretofore, we found, from Madras, woods for wagon-making, and the woods of South India; from Malabar, teak-plants set between 1844 and 1863, and woods; also woods and bark from Coimbatore, and from the Nielgherry Hills. There were forest-products from Salem, from Madura, from North Arcot, from Cuddapah, from Tinnevelly, from South Arcot, from Kurnool, and from Gowalpara, in the Himalayas; also woods from the central provinces, and from Mysore, and timbers from Berar.

47. AUSTRALIA.—VICTORIA.—From Melbourne was a collection of native woods and sections of trees.

48. NEW ZEALAND furnished a large collection of native woods, sections of the trunk of the *Dammara australis*, ship-timbers, section of the *Leptospermum scoparium*, of the "yellow pine," and botanical collections.

49. From TRINIDAD, (West Indies,) there was a very rich collection of tropical woods of two hundred and twenty-two kinds, of which the English names, with the French and Spanish names, were given, as well as their botanical titles, and the natural families to which they belonged. These furnished evidence of a very rich sylva in this island, most of which are native, though several have been introduced. Shown by Mr. S. Devenish.

50. JAPAN.—The exhibition from this far-off and wonderfully interesting country was highly creditable. Among the forest-products were wood-specimens of one hundred and seventy kinds, presented with their botanical names, carefully prepared, no doubt, by the celebrated botanist Siebold, whose son, Henry, was a member of the Japanese commission at Vienna. These trees embrace many species and some genera peculiar to the eastern hemisphere, but among them were recognized many names already familiar to American ears as those of plants now cultivated by ourselves. The bambusas were shown in quantities and of great size: and, though rather grasses than trees, they perform the office of the latter in construction, as was illustrated by the pavilions and other structures and fences in the park and garden, as well as by the furniture and apparatus shown within the palace, by these interesting and industrious people. There were also large collections of plant-products in different kinds, of dye-stuffs and tanning-material, consisting of galls and bark, charcoal from different trees, and the ashes from certain species that are employed in the glazing of porcelain.

In the garden, in the park, there was a large collection of plants, among which, besides those with beautiful flowers, there were many young trees peculiar to the country; among these, the *Quercus glauca*, for feeding silk-worms, and the *Acer palmatum*, with variously-colored foliage, were remarkable.

CHAPTER II.

SPECIAL EXHIBITS AT VIENNA.

THE SCHWARZENBERG PAVILION; ITS LOCATION AND THAT OF THE ESTATES; CHARACTER, EXTENT, AND STATISTICS OF THE EXHIBIT; THE SAXE-COBURG-GOTHA PAVILION; THE LOCATION AND CHARACTER OF EXHIBIT AND STATISTICS; FOREST-CULTURE; FAUNA; ORES; THE EXHIBIT OF THE AUSTRIAN STATE-RAILROADS; EXTENT AND CHARACTER OF EXHIBIT; FOREST-INDUSTRY.

51. THE SCHWARZENBERG PAVILION. — This was truly one of the gems of the exhibition on account of the architectural beauty of the building, its tasteful arrangement, both internally and externally, as well as for the varied character and richness of the exhibition of the products of the estates of the proprietors.

This pavilion was happily situated in the north zone, but a little eastward from the great dome, fronting upon the common thoroughfare on that side of the Industrial Palace, so that it was brought prominently before the passing throng, who could not avoid being attracted by the extensive and well-filled parterres through which it was approached.

These enterprising princes—father and son, John Adolf and Adolf Joseph Schwarzenberg—have possessions in Bavaria, in Styria, in Salzburg, in Upper and in Lower Austria, and also in Bohemia; the latter being the most extensive, occupying more than 387,000 acres. In Styria, they have 43,000 acres; in Bavaria, more than 6,000; in other places, 220 acres.

These diverse and widely-separated possessions embrace a great variety of climate, soil, surface, and geological formation; hence the diversity of products here exhibited, which are derived from the forests, quarries, and mines, and their manufactures, as well as from the rich fields of agriculture and horticulture, and also from their fisheries.

52. Confining myself to the notice of forest-products alone, these were found to be very extensive.

The doorway of the pavilion was ornamented with sections of great trees, and on entering the hall the visitor was delighted with the wild woodland and rock scenery, in which the native animals and birds of the forests were exhibited in their natural postures, showing the skill of the taxidermist.

The left transept contained the agricultural products in great variety, while turning to the right one found the products of the mines and forests.

Here were all sorts of finely-prepared woods; veneers for parquetry and other purposes, for bindery, &c.; round splinters for matches; resonance-boards for pianos and other musical instruments; specimens of parquetry-work with differently-colored woods, such as white pine

and larch: wooden shoes: wooden shovels and various other implements; finally, Faber's celebrated lead-pencils, made from their own famous graphite and cased in red-cedar wood grown in the country and declared to be better than that imported from America for the same purpose. Unfortunately, however, little or none of this valuable wood has ever been grown in European forests.

Tree-seeds.—These were exhibited in great variety, in buckets that were made of the very wood from which the seeds had been gathered: *Acer pseudo-platanus*, *Acer platanoides*, *Æsculus hippocastanum*, *Alnus glutinosa* and *incana*, *Betula alba*, *Carpinus betulus*, *Fagus sylvatica*, *Fraxinus excelsior*, *Quercus sessiliflora*, *Robinia pseudo-acacia*, *Spartium scoparium*, *Tilia grandifolia* and *parvifolia*, *Ulmus campestris*, *Quercus cerris*, *Abies pectinata* and *excelsa*, *Pinus sylvestris*, *uliginosa*, and *cembra*, *Larix europæa*.

Wagon-maker's lumber of every kind was exhibited, and cooper's stuff; also, the withes used in securing logs together in the rafts; secondary products, such as tan-bark from the spruce and oak, natural and pressed for transportation; turpentine, in flasks; tar; charcoal; and bast, from linden.

There were forest-models of means of transport, of rafts on the Elbe, of log-roads in the Boehmer-Wald, &c.

Tables represented the various subdivisions (*Reviere*) of the forests, with their different kinds of trees, ages, and management; and charts of the domains of Krumman, Wittingau, Winterberg, Stenbenbach, Frauenberg, Protiwin, Liebiejitz, Netolitz, Labositz, and other forest-regions were hung on the walls, with photographs of various interesting points, such as the sawmills and workshops, parts of the famous *Urwald*, which has not been invaded by the ax for centuries, and of the terrible windfall that desolated part of the forests with the furious storm of October 26–27, 1870.

Herbariums of forest-plants from different domains, and collections of insects, and of the results of their injuries, were extensive and interesting objects of study.

The zoological collection of the wild animals and birds embraced more than a hundred specimens; and there were prepared fish from the numerous *Oeiche* and lakes of these estates, besides having specimens in the ponds outside, where also were living beavers.

Outside and in the rear of the pavilion was quite a lumber-yard of forest-material, some of which must be mentioned in this report, beginning with the logs of trees.

53.—TABULAR STATEMENT OF NAMES AND CONDITIONS OF EXHIBITS.

Name.	Age.	Diameter.	Height.	Contents.	Raum.	Elevation.	Remarks.
	Years.	*In.*	*Ft.*	*Cu. ft.*	*Formzahl.*	*Ft.*	*Soil, &c.*
Spruce	225	34	144	420	.48	1,350	With fir and beech on gneiss, in gravelly humose loam, easterly slope.
Silver-fir	180	24	132	250	.60	1,400	Do.
Oak, (*Q. sessiliflora*)	195	27	96	224	.58	1,300	Gneiss, stony, humose loam; southerly; with spruce, Scotch pine, linden, &c.
Winter-linden	180	30	90	240	.54	1,300	Do.
Birch	75	20	78	104	.61	1,450	As above, with linden, aspen, some beech and oak, very thick bark.
Beech	120	18	66	93	.56	1,350	Northern slope; soil as above; beech-woods, with some spruce and fir.
Scotch pine	215	24	96	156	.50	1,400	Loamy sand, Tertiary formation.
Oak, (*Q. pedunculata.*)	230	21	84	105	.52	1,340	Loamy sand, Tertiary, with fir, spruce, and some ash.
Scotch pine	230	29	108	234	.47	1,350	Loamy sand, with fir, spruce, and some ash.
Moor-pine, (*P. montana.*	215	10	39	10	.47	1,300	Turfy soil.
Do	140	13	55	23	.45	1,300	Turfy soil, with *Carpinus.*
Alder	80	12	54	17	.40	1,300	Turfy soil, alone.
Black poplar	62	42	60	294	.51	.....	Low, wet land; in park at Wittingau.
Spruce	340	18	36	39	.51	3,250	Frosty place.
Do	320	11	36	11	.46	3,250	Frosty, on gneiss.
Do	580	26	66	90	.37	3,350	Gneiss, stony loam, northwesterly slope, fir-wood, *Urwald.*
Do	245	40	108	260	.27	4,030	Granite, stony, humose loam, westerly slope, fir-wood.
Do	530-550	17½	.....	.....	.....	3,500	Gneiss, large stones, easterly and northeasterly slope; sheltered from storms; sandy loam, rich in humus of centuries; spruce, fir, some beech, occasionally a maple.
Do	350	60	150	1125 (.65-.35*)	.38	2,300	
Do	300	48	120	687 (.59-.41)	.43	3,000	This and the next seven are from the famous *Urwald* of the Schattawa Revier.
Fir	350	52	132	935 (.72-.28)	.48	2,800	
Do	320	54	120	693 (.72-.28)	.36	3,500	
Beech	360	36	78	373 (.73-.27)	.68	2,600	
Do	280	39	108	385 (.72-.28)	.43	2,900	
Maple	330	25	66	119 (.72-.28)	.53	300	
Do	250	22	54	92 (.52-.48)	.64	3,800	
Spruce	115	12	39	7	.24	4,290	This and the four following are from the *Kelm-Revier*, Winterberg, the north slope of Klebani Mountain, 4,296 feet high, on gneiss, sandy loam, with much feldspar, clear spruce-forest, unmixed.
Do	120	12	65	28	.43 .54-.18†	3,880	
Fir	140	12	83	30	.46 .60-.21	3,460	
Do	130	19	131	112	.47 .93-.86	2,920	
Do	130	21	127	131	.43 .97-1.00	2,920	

* These figures in parentheses () signify the proportion of timber, (*Nutzholtz,*) shown by the first figures, to that of mere fire-wood, shown by the last figures.

† The first of these numbers represents the *Höhenzuwachs,* and the second the *Massenzuwachs.*

Tabular statement of names and condition of exhibits—Continued.

Name.	Age.	Diameter.	Height.	Contents.	Baum.	Elevation.	Remarks.
	Years.	*In.*	*Ft.*	*Cu. ft.*	*Formzahl.*	*Ft.*	*Soil, &c.*
Maple	450	31	84	337 (.85-.15*)	.76	3,000	Easterly slope, with fir, spruce, and beech, in the *Urwald* of Krummau, Revier Schwarzwald. Next ten from same district-domaine.
Spruce	110	13	108	50	.50 .98-.46	2,350	Granite, coarse sand, humose loam, much feldspar, with some fir and beech. This and the five next are from the easterly slope of the Plockenstein, which is 4,351 feet high, the highest point of Bahnewald, granite; soil, coarse, sandy loam, with abundant feldspar; forest is spruce with some beech and fir, the first reproduction of the *Urwald*.
Do	160	12	68	31	.62 .63-.31	2,500	
Do	197	12	48	14	.37 .45-.13	3,350	
Do	207	12	42	13	.40	4,300	
Beech	215	12	87	.....	.....	2,450	
Silver fir	60	21	48	15	.45	3,410	
Spruce	90	21	102	101	.41 1.13-1.12	2,840	This and the two next are specimens of the relative growth of spruce, fir, and beech in the mixed forest of the Plankerswald, a spur of the Bahnewald, of which the highest point is 3,416 feet; granite.
Fir	100	17	84	50	.48 .84-.50	.....	
Beech	100	12	78	28	.44 .71-.21	.....	
Spruce	70	12	51	18	.41 .73-.25	3,400	This and the next are from clear spruce forest, on the northeasterly slope of Plankerswald.
Do	65	12	75	27	.46 1.17-.41	2,800	
Do	100	15	60	50	.63 .60-.50	1,520	Chalk formation, clear spruce forest, with the next six, come from district Domauschitz, in Northern Bohemia, from Reviers Domauschitz and Rotschow.
Larch	75	16	72	66	.61 .96-.88	1,520	Chalk formation, Pläuer kalk, clear larch forest.
Locust	30	12	31	15	....	1,300	*Rothliegendes*, exposure northwest a wide-row plantation.
Walnut, (*Juglans nigra.*)	30	11	12	15	.....	650	Alluvium, avenuetree, (*Alleebaum.*)
Ash	75	30	33	146	.....	700	Diluvium, in a bowl-shaped sink-hole.
Spruce	75	21	97	112	.48 1.20-1.49c	1,100	Clear spruce forest at the foot of a western slope, *rothliegendes*, strong loamy soil.
Larch	70	21	73	86	.48 1.04-1.22c	.....	*Rothliegendes*, strong loam, at base of western slope.
Field-elm	90	38	69	193	....	.....	Northwestern slope, on basalt, a shade left in undergrowth of oak-forest.
Service-tree, (*Sorbus terminalis.*)	140	22	29	66	.....	.....	Do.

*These figures in parentheses ( ) signify the proportion of timber (*Nutzholtz.*) shown by the first figures, to that of mere fire-wood, shown by the last figures.

Tabular statement of names and condition of exhibits—Continued.

Name.	Age.	Diameter.	Height.	Contents.	Baum.	Elevation.	Remarks.
	Years.	*In.*	*Ft.*	*Cu. ft.*	*Formzahl.*	*Ft.*	*Soil, &c.*
Oak, (*Quercus cerris*)	195	40	77	295	.44	1,000	Gentle easterly slope, in loamy, coarse-grained sand, Vienna sandstone, grew in a sheltered forest of beach and hornbeam, of one hundred and sixty years' growth.
Larch	125	36	101	226	.31	2,400	Diluvium of the Mur River, on a northern slope.
Do	125	28	114	166	.34	4,800	Mica-schist, steep northern slope.
Do	180	42	95	300	.33	5,200	Mica-schist, steep southwest slope.
Stone-pine	300	21	84	90	.44	5,200	On a steep southern slope, protected by a thick plantation.
Do	165	26	49	94	.52	5,600	(*Kohlenschiefer,*) northwesterly gentle slope.

The next are curiosities and abnormal forms.

Name.	Age.	Diameter.	Height.	Contents.	Baum.	Elevation.	Remarks.
	Years.	*In.*	*Ft.*	*Cu. ft.*	*Formzahl.*	*Ft*	
Moor-pine	130	7	24	35.		1,200	From the turfy lands of Wittingau.
Do	105	2½	16	0.4		1,200	
Firs	110	8	24	3.		3,350	From the higher parts of Balmurwald, very frosty place.
Firs, *b*	150	7	18	1.6		3,350	Do.
Firs, *c*	260–280	6	15	1.3		3,000	On high moor.
Firs, *d*	100–110	3½	9				
Firs, *e*	220	7	18	2.5		3,200	
Firs, *f*	185	5½				4,350	From the Plockenstein.
Mountain-pine, 6 sticks, (*P. montana.*)	70–150	3–5				3,250 3,550	From Stubenbach.
Mountain-pine	130–140	5½				4,300	From the high moors of Domain Stubenbach, between the great rocks on the Suzen Mountain.
Mountain-pine, *c*	165	8				3,350	From the Stone Lake of Plockenstein, in Domain Krummau.
Mountain-pine, *d*	120	3½–3¼				6,000	Grew on the mica-schist of the Alps of Domain Murau.
Alpen erle, (mountain-alder.)	70–90	3–4½				6,000	Do.
Juniper	95	8					At Frauenberg in Bohemia.

Abnormal and injured or diseased.—Curious and misshapen roots: An enlargement on the stem of a spruce; a union of a maple ninety years old, 11½ inches in diameter, with a beech of eighty years, 8 inches in diameter.

54. Sawed, hewed, and split lumber of fine quality was shown; lumber for farming and for ship-building; of the latter, some timbers were from 40 to 60 feet long, 10 by 10 inches, and 12 by 14 inches square;

and there were spruce boards, from 111 to 126 feet long and 23 inches wide.

The split boards were most remarkable for their perfection and for their great length, being from 15 to 18 feet long, 10 to 14 inches wide, and from half an inch to two inches in thickness, as regular and even as though sawed. These were from spruce, fir, and larch. Those from oak and beech were thicker.

55. I cannot leave this most interesting place without referring to the very rich collection of living plants in the parterres in front of the pavilion. Passing by the representations of all the grain, forage, and other plants of agriculture, and the flowering representations of the horticulture of these estates, let us take a glance at the orchard and forest representatives here present:

Young plants of fir, from the seedlings, produced upon the ground, to those of one, two, and three years, once transplanted; yearling Scotch pines; of firs, seedlings of plants of from one to three years; of larch, seedlings and two-year old stone-pine plants of one and two years.

Oaks; an exceedingly rich collection of species and varieties.

Quercus pedunculata.—Seedlings and nursery-grown, two years and up to eight years old.

Quercus sessiliflora.—Seedlings and nursery-plants to five years old.

Quercus cerris.—Seedlings to four years.

Quercus pedunculata-pyramidalis.—Four years and from four to eight years.

Quercus pannonica.—*Tri-color maculata.* (?)

Quercus fenessi and *macranthera.*—From six to ten years.

AMERICAN SPECIES OF OAKS.

Quercus rubra.—From two to four years and seedlings.

Quercus macrocarpa.—From four to ten years old.

Quercus coccinea.—Four years old.

Quercus ulba.—A rare species in Europe.

Quercus "castanea."—This, I think, is *discolor.*

Quercus palustris and *Quercus nigra.*

Our oaks are highly prized in Germany for park-planting; but, unfortunately, great confusion exists in the naming among some of the propagators.

Fraxinus excelsior.—Seedlings and nursery-plants of three and four years.

Fagus sylvatica.—Seedlings and plants from four to eight years.

Carpinus betula.—Seedling and plants from three to four years old.

Ulmus campestris.—Five years old.

Acer pseudo-platanus.—Seedlings four to six years.

Acer platanoides.—The same.

Tilia grandifolia.—In seed-bed, and from three to eight years old.

Alnus glutinosa.—In seed-bed, and four year old plants.

Also plants, forest-seedlings from the *Urwald* or original native ancient forests of Bohemia, attached to the decaying logs, to illustrate the natural reproduction of these forests.

Altogether the spaces allotted to these young forest-trees were admirably arranged in their grouping, so as to be not only beautifully attractive to all who passed by, but peculiarly instructive to those who could appreciate their importance to the great study of forestry.

I cannot leave without referring to parterres devoted to fruit-trees in pots, dwarfs, espaliers, cordons, and high stems. These were shown in quantity, beautifully arranged in groups that displayed the ripening fruits during the season. Of these, there were more than two hundred apple-trees, about one hundred pear-trees, chiefly dwarfs, and bearing, plums, cherries, peaches, apricots, and other fruits and nuts.

56. To those who enjoyed the privilege of studying this exceedingly rich and practically interesting collection, no apology will be needed for occupying so large a space in this report with the foregoing sketch of the collective wealth of the estates of these eminently representative men.

Fortunate the government that has its territory owned and occupied by such practical and useful princes, who direct their energies to the utmost development of all the resources of their land.

I have dwelt the more willingly upon these forest-products, here so richly displayed, not merely because of their unquestioned merit, but also because of a sort of personal interest in them, fostered by a careful examination of extensive portions of the estates in Southern Bohemia, where, during a week's excursion, I was enabled, by the exceeding kindness of the proprietors and their officers, to see the arrangement and practical workings of some of the best forest-management of the country, the details of which may become very useful in our own land if properly appreciated and applied.

57. Pavilion of Prince Saxe-Coburg-Gotha.—Immediately to the north of the Schwarzenberg pavilion was another very pretty structure, containing the collective exhibition of agricultural, forestal, and mountain industries from the estates of Prince August of Saxe-Coburg-Gotha, which lie in Austria and Hungary.

Passing the extensive collection of agricultural products, we come to those of the forests, both natural and prepared.

Here was a very extensive collection of wooden blocks, in book-form, embracing almost every kind. There were two hundred and fifty-four of these pieces, many of which of course were duplicates; but they included all the species cultivated, and were a most interesting study.

Next was a very large group of the same species in cross-sections of the stems, amounting to more than three hundred pieces, a few of which will be mentioned. Some of them are of good size relatively to their ages and species, and some are cited to show how small was their growth compared to the same kinds in our own land.

58. In this collection also will be noted the occurrence of some trees not usually found in the forests of Europe.

The diameter, age, and character of soil were given, and, in some cases, the elevation above the sea-level.

	Diameter, inches.	Age, years.	Elevation, feet.	Soil, &c.
Silver-fir	47	330	.....	Clay.
Do	2	114	3,090	Chalk.
Norway spruce	21	190	.....	Do.
Do	34	90	.....	Do.
Norway maple	23	185	.....	Do.
Beech	31	230	.....	Do.
Do	6	65	.....	Chalk soil.
Birch	22	100	2,000	Clay.
Do	16	125	.....	Do.
Do	23	190	.....	Sand.
Larch	27½	130	.....	Clay.
Do	12	154	2,600	Do.
Do	6	120	.....	Chalk.
Scotch pine	28	100	3,000	Clay.
Do	3	24	.....	Loam.
Do	15½	115	2,370	Chalk.
Oak, (*Q. robur*)	23½	140	.....	Clay.
Do	37	106	.....	Loam.
Oak, (*Q. pedunculata*)	35	230	.....	Clay.
Oak, (*Q. cerris*)	15	153	.....	Loam.
Do	7	60	.....	Do.
Ash	12	50	.....	Do.
Elm	18	100	.....	Chalk loam.
Hornbeam	15	60	.....	Do.
Do	4½	36	.....	Loam.
Black poplar	63	300	.....	Sand.
Do	18	33	.....	Loam.
Lombardy poplar	46	200	.....	Sand.
Aspen-poplar	44	200	.....	Do.
White willow	18	80	.....	Do.
Black willow	11½	31	.....	Do.
Apple	9	67	.....	Sandy loam.
Pear	11	36	.....	Do.
Field-elm	17	100	.....	Do.
Do	8	74	.....	Do.
Plum	10	60	.....	Do.
Field-maple	9	86	.....	Do.
Hazel-nut	4	34	.....	Do.
Yew	5	80	2,800	Chalk.
Do	3½	118	2,800	Do.
Do	6	46	2,800	Do.
Do	1½	85	2,800	Do.
Thorn	6	46	.....	Sandy loam.
Black locust	23	27	.....	Sand.
Do	2	28	.....	Loam.
Do	1	1	.....	Sand.
Do	2	2	.....	Do.
Ailantus	13	24	.....	Do.
Pine, (*Pinus pumilio*)	6	85	4,900	Clay.
Juniper	5	60	2,600	Do.
Do	3	60	.....	Do.

Various abnormal and diseased growths were also present, some of which were very curious and interesting.

Numerous charts, plans, and photographs illustrated the different forest-reviers, and the tables of statistics showed their annual expenses and production.

59. Forest-products and apparatus, specimens of charcoal made from different kinds of wood, and from the same woods of different ages, made a group for study. The coaling-apparatus used, coal-wagons, &c., were also exhibited, and wagons for the transport of logs and wood. A raft, composed of eleven spruce logs, 10 klafter long, (60 feet,) with

its appurtenances, oars, levers, pulleys, &c., was shown. This was loaded with all sorts of prepared lumber, shingles, &c., ready for transport; among the products, locust posts were observed.

There were railroad-sleepers, some of which were of larch. Their size was from 6 by 9 inches to 6 by 12. Those 8 by 11 to 8 by 14 inches were called extra. Also wagon-lumber of oak, beech, and hornbeam; and wagon-wheels made from a combination of elm, locust, and ailantus. The latter is used for the felloes, while the spokes were of locust and the hubs of elm. Ox-yokes and tool-handles also were made from the ailantus.

There were various implements made of wood, such as shovels for different purposes, meal-troughs, bread-bowls, &c.

Very pretty rustic tables and seats were made from birch and hazel, and especially noteworthy was a garden-table, the top of which was a section of poplar 42 inches in diameter. The feet, of crooked spruce stems, were of alpine growth.

60. Forest-culture was illustrated by various seeds and seedling-plants; acorns of the different species, and seeds of other forest-trees. Living plants of spruce, fir, pine, larch, and others, deciduous species, such as maples, oaks, and black locusts from two to six years old, were growing in the soil.

The wild animals belonging to the forests were represented by more than one hundred specimens elegantly set up.

Then came a large collection of the iron-ores of the estates, and the iron-production in various stages up to the finest iron and steel.

Altogether, this pavilion was a very attractive place.

61. EXHIBIT OF THE AUSTRIAN STATE-RAILROADS.—In the north zone was a pretty pavilion erected by the Austrian State Railroad Company, in which were displayed not only the machinery and apparatus connected with their great organization, but also the products of the mines, lands, and forests of their extensive and widely-scattered possessions.

It is with the latter that we have now to concern ourselves, leaving the rest of this very interesting display to the care of the appropriate reporter.

62. From the forests of Banat in Southern Hungary, near the line of Turkey, on the Theiss and Danube Rivers, was a collection of sections of logs of useful trees.

A collection of similar woods was exhibited in three-sided prisms.

Young trees for forest planting were also shown, among which were oaks, larch, beech, firs, spruce, pines, (including our white pine,) and the *Pinus cembra*, or stone-pine, with other plants of forest-culture.

An herbarium of various forest-growths, and a collection of forest-seeds, embracing 92 species.

Among the secondary products of forest-industry were timbers, cross-ties, of course, with various other forest-wares, rustic furniture, &c.,

besides pieces of wood in cubes and other forms, with corresponding specimens of the charcoal, so important in their steel-works.

There were models of the water-ways for transporting wood to the collieries, and for floating the hewed timbers from the mountains.

Statistical tables of the products, of the annual yield, and of the growth or increase of the forests, as well as of the production of wood and coal, produced by them, were presented, with maps of the company's domains and forests.

When will our great railway-companies become creators and conservators as well as consumers and destroyers of the forests?

CHAPTER III.

FOREST-AREAS OF EUROPE.

GREAT BRITAIN; AREA OF BRITISH FORESTS, AND THEIR MANAGEMENT; EXTENT OF FOREST IN OTHER EUROPEAN COUNTRIES; GERMAN AND AUSTRIAN ADMINISTRATION AND METHODS OF INSTRUCTION IN FORESTRY; COLONIAL FORESTRY.

63. GREAT BRITAIN.—Great Britain is not so famous for her woodlands as the continental countries of Europe; and, although many of her historical forests are of a very inferior character so far as their quality and productiveness are concerned, there has been a great improvement in this respect, and many private plantations, as well as some that are managed by the state, have been conducted upon more scientific principles within the present century, and have been made very profitable. Captain Walker gives an aggregate of the royal woodlands of England at 58,606 acres, covered with productive forests, in an area of 169,306 acres To much of this latter the title is mixed, and it is often hampered by servitudes to such an extent that it is unworthy the name of forest. In Scotland, the properties of the Earls of Seafield and Mansfield and of the famous Duke of Athole amount to 60,000 acres of veritable forest-lands, in which the Scotch pine and the European larch are largely grown.*

These figures, in a total of 118,606 acres, do not include the many smaller plantations of numerous private individuals.

From my own observations in the so-called Epping forest, there was very little to be seen that deserved the name in comparison with the well-managed and cultivated forests of Germany. There were trees old and young; some are very ancient. There were numerous coppices, some of which were looking well, but the mass was simply an extent of neglected commons, with patches of woods badly managed, and with frequent openings of cultivated lands, and other wide spaces that are partially covered with useless bushes. These furnish a meager pasture, and provide a favorite resort for wandering gypsies.

64. The first feeling was one of surprise and regret that so much land should be lying idle and unproductive near the great metropolis of the world, where many thousands of its inhabitants were suffering for the need of supplies, which might be furnished by this land if it were properly cultivated.

The traveler recently from the Continent cannot avoid contrasting

* Forest Management; By Capt. Campbell Walker, F. R. G. S., Deputy Conservator Forests, Madras. Parliamentary report, London, 1873.

the well-managed forests he has left behind him with these unproductive woods, and estimating the favorable results that would follow a judicious planting and cultivation of these tracts. Upon inquiry, however, he will find that nearly all the forests of England were originally hunting-parks, and a little investigation will show him that this was the original meaning of the term *forest* in our language. The antiquity of the tenure of some of these tracts is so great that it is lost in oblivion. Even in the time of the Saxons, a great part of the crown-lands were devoted to animals of the chase, and were kept for the amusement of the king, and from which all other persons were excluded. William the Conqueror is said to have had 68 forests, 13 chases, and 781 parks; the latter only were inclosed. In those days, the forest was a preserve for game, not a place for the production of timber. The forest-laws were very oppressive, and, at the time of the issuing of Magna Charta, King John found it necessary to make other concessions to the demands of the people, and, with certain reservations of favorite forests, "he gave up all others in quiet to the churches and the kingdom." In Magna Charta itself it was granted that all the lands which had been afforested (devoted to the chase) in his time, should be disafforested, or restored to cultivation and occupancy by the people.

Even now it seems a source of trouble to the citizens, who are very jealous of any trespassing by inclosures of the smallest portions of this public property, and questions are constantly arising where the occupants of ancient leaseholds are required to give up their possessions by their jealous countrymen.

As already observed, however, a great change has been effected in the forest character of these demesnes within the present century, and extensive plantations have been made in the endeavor to improve the productiveness of these lands. This is very manifest in the woods attached to the great park at Windsor, which is not only a very beautiful estate, but contains some admirably-managed woods.

Here one may see both systems: the park with its numerous deer pasturing among the venerable oaks of centuries' growth, which are "stag-headed" and gnarled enough to please the painter and the lover of the picturesque, is contrasted with younger plantations of the same species that have been reared under the most judicious management.

Here, too, you may see groups of various kinds of trees from many lands, that have received proper care; among these the groves of tall chestnuts are remarkably fine, and the American oaks are growing beside the cedars of Atlas, of the Himalayas and Lebanon, while the firs of Asia and America equally assert their claims to admiration.

The undergrowth, too, is beautiful and abundant; acres of rhododendrons and laurels furnish a perennial green, contrasting in winter with the russet of the brackens, and with them providing a perfect cover for the pheasants.

The following are the leading forests of England: Windsor forest

and Waltham forest in Essex; the forest of Dean in Gloucester; in Hampshire are New forest, Woolmer, and Aliceholt; in Northamptonshire, the Rockingham, Whittlewood, and Salcey forests; in Nottinghamshire is the Sherwood forest; and in Oxfordshire is Whichwood.

England does not appear by any means a treeless land. Excepting upon the downs, the traveler will find plenty of trees, which contribute in no small degree to set off the beauties of the landscape; these are often in the hedgerows, in clumps, in coppices, and in small woods.

65. HOLLAND AND THE NETHERLANDS.—Holland has her forests. Notwithstanding the advanced state of her agriculture, she produces some wood and timber. The trees consist chiefly of beech, fir, poplar, and ash in woods and coppices; willows and poplars are grown along the canals. In the coppices, there are also maples, hornbeam, birch, and oaks. In Guilderland, there are extensive forests of firs and American white pines, and hundreds of acres have been planted with acorns. At Rhenen and at Arnhem are thick woods, and plantations have been made on the Upper Yssel. The proportion of woodland could not be ascertained, but it cannot be large.

BELGIUM.—In 1866, this country had 1,074,393 acres of forest in her territory of 6,796,800 acres, or less than one-sixth of the whole in woodland.

66. FRANCE.—France has many fine forests, and is favorably situated for the production of a variety of useful trees. The woods are distributed over the country. Most of the provinces have considerable tracts of woodland; some have from one to two hundred thousand acres each; a few have from two to three hundred thousand, and some as much as from four to six hundred thousand, while the department of Dordogne alone has more than a million acres. There is a total of 21,983,000 acres of forest in her territorial area of 133,380,000 acres, being rather less than 17 per cent., or say one-sixth, wooded. This estimate has been put as low as one-seventh of the total area.

67. SWITZERLAND.—Switzerland, according to Püschel,* has 1,513,492 acres, being more than one-sixth of the whole area, much of which is bare mountain-tops.

68. SWEDEN and NORWAY together have a large area of forests. South of latitude 64°, one-fourth of the surface is covered by woods. Sweden has 17,568,000 hectares † of forest-surface, from which is derived annually ‡ 1,150,000,000 cubic feet of timber, 890,000,000 cubic feet of which is burned chiefly as charcoal. The lumber is largely shipped to England, France, and Belgium. Norway has 13,000,000 hectares in wood, from which she draws timber for sale to the value of $8,000,000 annually. The author of the descriptive catalogue already referred to sug-

* *Forst-Encyclopoedie von Al. Püschel, Leipsic*, 1860.

†A hectare is equal to 2.47 acres.

‡*Schweden Statistiche*, von Dott. Elis Sidenbladh Stockholm, 1873.

gests the division of Norway and Sweden into three zones, according to the character of their flora, as follows:

First zone.—The region of the beech and the hornbeam. This is Southern Sweden, and extends from the most southerly part, in latitude 55°.20, to 57°.5, on the eastern, and to the fifty-ninth parallel on the western coast. In this region, wheat and other grains grow well, as do all the fruits that succeed in England; with some care, such tender plants as the *Aucuba japonica*, *Broussonetia papyrifera*, *Bignonia radicans*, *Catalpa syringafolia*, *Hibiscus syriacus*, *Paulownia imperialis*, and others. The *Robinia pseudo-acacia* thrives as well here as in Southern Europe. The *Castanea vesca* is to be found one hundred and fifty years old; the box between two hundred and three hundred years, and with a diameter of 8 inches. Many conifers, such as *Thuja plicata* and *occidentalis*, *Salisburia*, Irish yew, and Lawson's cypress, grow finely. The liriodendron is to be seen 30 feet high and bearing its blossoms, and in one place is the *Magnolia acuminata*, 40 feet high and 1 foot in diameter. At Göteborg, on the west coast, the climate is milder. *Amygdalus communis*, *Azalia spinosa*, *Wistaria sinensis*, *Hydrangea hortensis*, *Ilex aquifolium*, *Chamæ cyparis*, *Cephalotaxus;* the pines from the western coast of North America, such as *Douglasii*, *grandis*, *Menziesii*, &c., and even the *Sequoia gigantea* of California thrive well. The natural sylva is characterized by the *Sorbus aria*, *Acer campestre*, *Euonimus europæus*, *Cornus sanguinea*, &c.

Second zone.—The region of the oak extends northward to latitude 62°.20 on the east coast. Rye, barley, and oats are the leading grains produced. Fruits are grown; the apple does well. In favorable summers, the walnut ripens, and even grapes, especially the American sorts, and apricots. In the region about Stockholm, among others, the following trees succeed well: *Acer negundo*, *Æsculus macrostachya*, *Ailanthus glandulosa*, *Castanea vesca* as a bush 8 to 10 feet, *Crataegus pyracantha*, *Cupressus lawsoniana*, *Cydonia japonica*, *Liriodendron tulipifera* as a bush 6 feet, *Mespilus germanica*, (fruits annually,) *Abies canadensis*, *Abies orientalis*, *Picea ephalonica*, *Cilicia nordmaniana*, *Quercus coccinea*, *Rhododendron cataubiense* and *dahuricum*, *Ribes*, *Spiræas*, *Wiegelias*, &c. The native growths consist of *Fraxinus excelsior*, *Acer platanoides*, *Ulmus montana*, *Tilia europæa*, *Alnus glutinosa*, &c.

Third zone.—The region of the *Alnus incana*, the conifers, and birch, occupies Norsland to the bounds of the Swedish mountains in Lapland. Barley is the chief grain, but rye is sown, and sometimes wheat also. Flax and hops are produced even in high latitudes. Red and black currants and other kinds of berries are native. The season of growth is very short, being from two to three months at most. The snow is deep and the winters severe. The ash is often killed. The sylva of this region consists of low-growing plants that may be covered by the snow, and only the most hardy trees, among which the following stand unprotected: *Picea balsamea*, *Pinus austriaca*, *P. cembra*, *P. mughus*, *Populus balsamifera*, *P. laurifolia*, *P. candicans*, *Pyrus baccata* and *pruni-*

folia, *Thuja occidentalis*, *Sorbus aria*, &c. Besides the native conifers and the birch, there are the *Alnus incana*, *Prunus padus*, *Sorbus aucuparia*, *Populus tremula*, and willows, from all which a pretty good native forest is made up. These particulars have appeared so interesting as to justify their introduction into this report, as showing how in this northern region there appears a mixture of the arctic sylva with that of Southeastern Europe, a mingling of the Caucasian flora with that of the extreme north. It might be an interesting query, How much of this is owing to the influence of the great ocean-stream flowing from the coasts of tropical America?

69. RUSSIA.—Russia has very extensive forests, especially in her northern provinces. They amount to nearly 500,000,000 acres, or more than one-third of the whole territory of that empire; but much of this is said to be in a comparatively unproductive condition.

Russia has more forests than other European countries. Birch abounds to the fifty-fifth parallel; pine and firs are found in great extent farther north. In the government of Perm, there are 47,000,000 acres of forest in an area of 50,000,000 acres. Conifers extend to latitude 57°; birch, aspen, and linden reach to 54° and 55°; oak succeeds at 51° to 52° on the plateau, but is best in the valley of the Volga at 55°.

Finland has extensive forests of firs and pine in the southern portion, interspersed with oaks, elms, &c. In Northern Lapland, these are replaced by the birch until trees cease altogether in the coldest districts. The mountains are generally bare or covered with low growth.

The wild crab is found to the sixtieth degree; the oak, to the sixty-first; the ash, to the sixty-second.

Finland has a special forest account or bureau for the management of the state-woods, the extent of which is 29,681,088 tonnen, or 36,210,927 acres. This is divided into 52 reviers and 565 districts. The districts are managed by forest-masters; the reviers, by over-forest-masters, all under the control of an upper director.

A forest-institute for theoretical and practical training is to be found at Ewois.

"According to recent statistics,* the extent of the forests of Russia in Europe is about 442,897,500 acres, or 40 per cent. of the whole area. The forests are very unequally distributed, and internal communication is still very imperfect in many parts of the empire; hence much of this wealth is at present unavailable. Every year, however, the facilities for transport are increased, and there is a corresponding augmentation in the amount realized. Nearly 65 per cent. of the forest-land is situate in the four governments of the North Archangel, Vologda, Olonetz, and Perm; this equals sixty-five acres to each inhabitant. The governments of the south are relatively poor in timber, and in some parts almost treeless; but since 1842 the forest-administration has been engaged in remedying this defect by planting largely. Between 1866 and 1870

* "*Notice sur les forêts et leurs prodnits*," etc., *par P. N. Werekha*, quoted in "Nature."

upward of 20,000 acres were planted, exclusive of the action of private owners.

"The value of the forest-products exported in 1871 amounted to 16,026,553 rubles, of which more than one-third came to this country, (England.) But the internal consumption gives a better idea of the immense wealth of these forests. It is only possible to give an approximate estimate of the value, which Mr. Werekha states must be at the very least 265,450,000 rubles per annum.

"The most destructive industry, so far as the forests are concerned, is the manufacture of bast mats, bark shoes, (*lapti.*) cordage, and other articles prepared from the liber or inner bark of the lime, birch, and willow, chiefly of the former tree. It is computed that 100,000,000 pairs of *lapti* are made annually, each pair requiring the bark of four young trees; thus 400,000,000 trees are cut down every year for shoes! Lime-trees, from five to ten years of age, and half-grown birch, are employed for this purpose. Such reckless waste is much to be regretted; and Mr. Werekha observes that the pines are tapped for their resin, and bled to death in from ten to fifteen years, in the same way as the Landes of Gascony were denuded of their pine-forests during the last century."

70. SPAIN.—Spain has 11,725,213 acres of forests, which are classified as belonging to the state, to the communes, and to establishments or endowments. They are also characterized by their contents, as of pine, of oak, and of beech. Compared to the total area, her forests occupy nearly 10 per cent., but much of the wood is said to be scattering and indifferently managed.

The following trees are either native or naturalized, and are now growing in the forests of Spain:

Abies pectinata and *pinsapo*, *Acer pseudo-platanus*, *Alnus glutinosa*, *Amygdalus communis*, *Betula verrucosa*, *Buxus sempervirens*, *Castanea vesca*, *Celtis australis*, *Ceratonia siliqua*, *Cerasus capro* and *juliana*, *Cercis siliquastrum*, *Citrus medica*, *limoni*, and *aurantiacum*, *Corylus avellana*, *Cydonia vulgaris*, *Daphne*, *Erica scoparia* and *stricta*, *Fraxinus angustifolia*, *Genista florida* and *tridentata*, *Ilex aquifolium*, *Juglans nigra*, *Juniperus macrocarpa*, *phœnicia*, *sabina*, *sophora*, and *thurifera*, *Laurus nobilis*, *Melia azedarach*, *Mespilus germanica*, *Morus alba* and *multicaule*, *Pinus clusianus* or *hispanica*, *P. halepensis*, *P. hispanica*, *P. maritima*, *P. pinea*, *P. pinaster*, *P. sylvestris*, *P. uncinata*, *Persica vulgaris*, *Phœnix dactyliflora*, *Platanus orientalis*, *Populus alba*, *fastigiata*, *nigra*, and *tremula*, *Prunus domestica*, *Punica granatum*, *Pyrus communis* and *malus*, *Quercus coccifera*, *Q. ilex*, *Q. lusitanica*, *Q. pedunculata*, *Q. sessiliflora*, *Q. ruber*, *Q. tuza?* *Robiniapseudo-acacia*, *Salix alba*, *Aurita biennialis*, &c., *Sorbus aria* and *aucuparia*, *Taxus baccata*, *Ulex europæa*, *Ulmus campestris*.

Also the following shrubs:

Berberis vulgaris, *Chamærops humilis*, *Cistus albidus*, *lancifolius*, *ledrui*, *ladaniformis*, *monspeliensis*, *populifolius*, *salvifolius*, &c., *Daphne lamilla*,

Erismea pungens, *Machrolea tenacissima*, *Nerium oleander*, *Phylisnea argentifolia*, *Pistachia lentiscus* and *terebinthus*, *Rhamnus alaternus*, *Ulex provinsiata*, *Vibernum lantanoides* and *tinus*. This is given on the authority of a jury-colleague, Don Francisco Garcia Martino.

The following table shows the character of the growth, (species,) and the ownership of the woodlands of Spain:*

Proprietors.	Pine.	Oak.	Beech.
The state	591, 141	67, 941	34, 546
Communes	5, 231, 776	4, 290, 765	1, 134, 481
Establishments	264, 764	99, 087	.....

71. PORTUGAL.—The area of forest is computed at 5.3 per cent. of the total superficies. The state-forests embrace 20,013 hectares; besides these, there are 100,000 hectares in the possession of communes and individuals. The largest forest is that of Leiria, containing 9,914 hectares of sand-dunes, in which the *Pinus maritima* abounds. The other species are *Pinus pinea*, different species of oak, evergreen oaks, chestnut, alder, plane-tree, poplar, willow, mulberry, ash, &c. There are also trees of the second class that attain good size, such as laurel, arbutus, viburnum, holly, walnut, cherry, box, and others. There are also great patches of shrubs and bushes, among which are myrtle, broom, and thorns.

In the forest of Leiria, the *Pinus maritima* attains sufficient size and such excellent quality that it is highly esteemed for construction, both naval and civil. The fire-wood is in great demand at the glass-works of Manuha-grande. A portion of the forest, 1,632 hectares, is devoted to the production of resin, with an average of 132 trees per hectare, which yield 150,000 kilograms, or 330,000 pounds.

The country is poorly wooded, and individuals have exerted themselves to increase the plantations, especially in the western portions of the provinces of Beira and Estramadura, where there are stretches of idle land and hills covered with broom.

The cork-oak is much planted and yields a large income.†

The forest of Busaco is in the western portion, on the mountains of Alcoba, a few miles northwest from Coimbra. Its area is small, not more than 100 hectares, but it has fine woods and a historical interest, having been a religious retreat, founded in 1628 by Bishop D. Joao Manoel, for the Carmelites. After the abolition of religious orders, this was attached to the royal forests, and great pains have been taken to preserve and improve it. Here have been established a great nursery of indigenous trees and a garden of acclimatization for exotics. The oaks of different species are colossal. Many other trees of the second rank here attain their largest dimensions; but the glory of this forest is the so-called *cedar of Busaco*, the *Cupressus lusitanica*, (Tournefort,) said to

* Siemoni, *op. cit.*

† *Le Portugal. Alphonse Fiqueriedo, Lisbonne*, 1873.

have been introduced from the Azores in 1680. There are specimens 40 meters high and 5 or 6 meters in circumference at breast-high.

The recent plantations contain numerous specimens of many species of the leading forest trees from all countries.

72. ITALY.—Italy has 12,413,955 acres of forest-land, or in the proportion of less than one-sixth of the whole territory of the peninsula.*

Siemoni gives a table of the sixty-eight provinces, with their respective population, territorial area, and forest-area; also the relative proportions of these latter to the population.

The forests of Italy occupy an extent of 5,025,893 hectares, which is 17.64 per cent. of the whole surface; less than that of Germany, which is said to be 26.50 per cent., but greater than that of France, which is 16.79 per cent. It is claimed by writers on forestry that the best proportion for the prosperity of the state is 20 to 25 per cent. of woodland.

Italy has 0.20 of one hectare of forest to each inhabitant; Germany has 0.37; and France has 0.27. The annual consumption of wood amounts to 30,342,220 cubic meters, of which 12,136,888 cubic meters are for construction, and 18,215,332 cubic meters for combustion.†

In a report ‡ on the forest-interests of Italy, very minute details are given of all particulars of this important branch of industry. With regard to their elevation and situation, forests-lands are divided into the alpine, found in the northern provinces, and the apennine, in the peninsular provinces, besides which there are those of the plains and the islands; in all of these, there are some differences in the sylva.

The alpine region covers about a million hectares. The species are *Pinus cembra* in small masses, at a height of from 4,250 to 7,860 feet. *Abies excelsa* grows in considerable masses at from 3,000 to 7,867 feet, and is often associated with the *Pinus cembra*, *Picea pectinata*, and the beech. *Larix europæa* is found from 3,000 to 6,500 feet, sometimes as low as 1,600 feet, forming extensive woods, either alone, or mixed with the *Pinus cembra*, spruce, fir, and beech. Fir (*Abies pectinata*) reaches from 3,300 to 5,800 feet in dense woods, alone, or associated with the preceding species. Beech (*Fagus sylvatica*,) grows at a height of 4,250 to 5,300 feet, in close woods, alone, or associated with the species named. This is the most valuable deciduous tree of the mountains. *Pinus sylvestris* reaches from 900 to 4,900 feet, and even to 1,900 meters in woods of small extent. *Pinus pumilis* is seen in the mountain-tops. *Pinus uncinata*, perhaps a variety *sylvestris*, at 4,000 to 5,800 feet. Ash (*Fraxinus excelsior*) grows at 4,800 feet. *Sorbus aucuparia* is found from 3,590 to 5,800 feet. *Sorbus aria* and *Sorbus terminalis* occur at 5,800 feet. *Betula alba* thrives at 6,500 feet; *Cerasus avium*, at 5,200 feet; *Acer pseudo-platanus*, at 5,400 feet; *Acer platanoides*, at 4,250 feet. *Ulmus campestris* is seen at 4,000 feet; *Car-*

* Government report on forest gives the total area of Italy 70,351,343 acres.

† *Relazione di Giovanni Carlo Siemoni sui boschi ed i loro prodotti all'esposizione universale di Vienna*, 1873.

‡ Official report, *supra*.

pinus betulus, at 3,700 feet. *Tilia europæa* and *Alnus incana* thrive at 4,000 feet; *Alnus glutinosa*, at 3,270 feet; *Corylus avellana* and *Castanea vesca*, at 4,000 feet; *Hippophæ rhamnoidies*, at 4,500 feet. *Taxus baccata*, which is rare, reaches 5,200 feet, and other shrubs are found with it. *Quercus robur* is only seen on the southern slopes at 3,600 and *Quercus pedunculata* at 2,900 feet in moderate amount.

73. THE APENNINE REGION.—In this subdivision, the leading species of trees are: *Fagus sylvatica*, generally seen at 3,200 feet elevation, but sometimes as low as 1,400 feet; *Abies pectinata*, at 2,100 to 6,200 feet, in great forests; *Acer pseudo-platanus*, at the same elevation, and *Acer campestris* at 3,000 feet; *Cerasus avium* grows from 2,600 to 6,500 feet; *Taxus baccata*, at 10,000 feet; *Alnus incana*, 2,600 to 6,500 feet; *Alnus glutinosa*, at 3,300 feet; *Betula alba*, 3,300 feet and rare; *Fraxinus excelsior*, about 5,000 feet; *Fraxinus ornus*, at 2,000 feet; *Sorbus aucuparia*, *Sorbus aria*, and *Sorbus turminalis*, from 2,000 to about 6,500 feet; *Ulmus campestris*, 5,000 feet; *Corylus avellana*, 5,600 feet; *Tilia europæa*, about 5,500 feet; *Ilex aquifolium*, about 9,000 feet; *Castanea vesca* and *Quercus robur*, at 3,300 feet; *Quercus pedunculata*, about 2,500 feet; *Quercus ilex*, 2,500 feet; *Quercus cenis*, about 3,300 feet; *Carpinus betula*, 6,500 feet; *Robinia pseudo-acacia*, at 2,000 feet; *Pinus laricio*, at 6,600 feet Other species, less abundant and at lower elevations, are: *Pinus bintia*, *Pinus halepensis*, *Pinus maritima*, *Cupressus sempervirens*, &c.

On the plains, the forests, which are scattered, have a combined area of 1,000,000 hectares. The rotation varies from three to eighteen years while in the elevated regions it is from twenty to eighty years. The reproduction of the forests is generally natural, occasionally artificial.

74. THE ISLANDS.—*Sicily.*—The treatment of the forests is similar to that of the southern apennine region, and often much worse. The sylva also is very similar. On Mount Etna, the beech reaches 7,000 feet. *Quercus robur* is seen at 7,000 feet on the southern slopes, and only reaches 5,600 feet on the northern. Of the chestnut, there is a specimen which reaches such a colossal size as to hold 100 horsemen in its hollow trunk; it has a circumference of 210 feet. This species reaches 5,400 feet on the south and east, and 3,800 feet on the north and west sides.

Sardinia, with an area of 2,425,018 hectares, has 1,045,522 hectares of woodland, or 43 per cent. These forests have not been well managed. The species correspond to those of the middle and lower portions of the Apennines. The most valuable tree is the cork-oak, (*Quercus suber.*)

75. These divisions correspond to the three zones of Siemoni.*

First zone, having an elevation of 7,900, down to 3,000 feet, is called alpine, and is characterized by the *Pinus montana*, *Pinus cembra*, *Pinus larix*, *Pinus picea*, *Pinus abies* or *peetinata*, *Betula*, *Fagus*, *Acer*, &c., abounding in conifers.

Second zone, called the apennine, having an elevation of 3,000 to 1,300 feet, and is characterized by the *Castanea vesca*, *Quercus cenis*,

* *Manuale teorico-pratico d'arte forestale di Giovanni Carlo Siemoni, Firenze*, 1872.

Quercus robur, &c. Chestnut, either alone or with the *Quercus cenis*, occupies the upper portions of this zone.

Third zone, from 1,300 feet to the sea-level. This is the region of the *Pinus pinea*, *Quercus suber*, *Quercus ilex*, *Pistacia lentisca* and *Pistacia terebinthus*, *Chamærops humilis*, *Erica multiflora*, &c. Near the sea-level is the *Pinus pinaster*, and near the upper portions the oaks.

M. Siemoni refers to Professor Schouw's six zones of Italian sylva:

1st. The region of broad-leaved evergreens, 1,200 feet high.

2d. The region of the oaks and chestnuts, from 1,200 down to 300 feet.

3d. The region of pines and firs, from 3,000 to 5,000 feet.

4th. The subalpine region, from 5,000 to 6,000 feet.

5th. The lower alpine region, with distinctly alpine flora, elevation 6,000 to 7,500 feet.

6th. The upper alpine zone, from 7,500 to 8,900 feet.*

In Italy, there is provision of 1.25 cubic meters of wood to each inhabitant; of this, one-half a cubic meter is lumber for construction, and three-quarters of a cubic meter for fuel, either as wood or charcoal.

The proportions of the several classes of forest are thus compared with to whole area in hectares:† Total forest-area, 5,025,893; deciduous, 4,473,365; conifers, 347,946; mixed, 204,582.

The average annual increase of the wood is 3 cubic meters in the *Scelta*, and 3.09 cubic meters per hectare in the close, tall, timber plantations, (*alto fusto.*)

76. GERMANY.—Because of the wealth of its production and the extent of population employed by it, as well as on account of the protection and ornament which it renders to the country, forestry is properly considered one of the most important departments of the German economy. Since the days of Charlemagne, who afforested the Ardennes and established the woods of Osnabrück, the sovereigns of this country have bestowed especial attention upon the forests, so that now German forestry is superior to that of all other countries.

Of the entire area of 2,600 square miles of woodland, 34 per cent. is held by the state, fully one-sixth by the communes, and not quite half belongs to private individuals.

Hochwald management prevails, being 81 per cent.; *Niederwald*, 19 per cent. Of this extent of forest, 55 per cent. consists of conifers and 45 per cent. of deciduous trees.

For the production of tanning-material, there are 125,000 hectares of oak-coppice, chiefly in the southwestern divisions. The net returns of the forests amount to from 2 to 12 thaler per hectare, so that, at 5 per cent. interest, we may assume the value of the land and its crop is $53\frac{1}{3}$ thaler per hectare. The forests therefore represent a capital of 666,000,000 thaler.‡

Grundzüge einer allgemeinen Pflanzengeographie, Berlin, 1823.

†Official report, *cit. supra.*

‡*Amtlicher Catalog der Ausstellung des deutschen Reiches, Wiener Weltausstellung, T. Bödiker, Berlin*, 1873.

77. The data here following have been gathered from various sources; he best that were at hand, and they suffice to give a glimpse of the acknowledged importance of forestry in European countries.

From these statements and tables, much instruction may be drawn, and it will appear that quite a large proportion of the country is wisely reserved for the production of timber, for the influence of the forests upon the climate, and also upon the consequent water-supplies of the continent.

*Forest-area and annual yield of the German empire, reduced to acres and dollars.**

Countries.	Area in acres.	Annual product.
Prussia	20, 666, 349	$39, 113, 316
Bavaria	6, 414, 328	13, 601, 274
Saxony	1, 166, 875	2, 933, 721
Würtemberg	1, 469, 902	3, 054, 962
Baden	1, 261, 982	2, 820, 300
INLAND STATES.		
Between Rhine and Elbe	1, 228, 773	2, 632, 822
Thuringian States	970, 856	2, 440, 895
Baltic States	667, 396	1, 305, 070
Alsace-Lorraine	1, 114, 802	3, 238, 754
Totals	34, 961, 273	61, 141, 114

The total area of the empire being 111,688,600 acres, the forests bear the ratio of 0.315, or less than one-third.

Of the Rhine and Elbe States—	Acres.
Hesse has	593, 005
Brunswick	282, 864
Anhalt	137, 952
Waldeck	109, 685
Schaumburg-Lippe	21, 444
Lippe	83, 822
Total	1, 228, 772

Of the Thuringian States—	Acres.
Saxe-Weimar	224, 614
Saxe-Meiningen	230, 762
Saxe-Altenburg	98, 343
Saxe-Coburg-Gotha	146, 545
Schwartzburg-Rudolstadt	95, 334
Schwartzburg-Sondershausen	62, 301
	28, 311
	84, 644
Total	970, 855

* *Die forstliche Ausstellung des deutschen Reiches auf der Wiener Weltausstellung*, 1873, *von Bernhard Danckelmann, kœniglich-preussischen Ober-Forstmeister, etc., Berlin*, 1873.

Of the Baltic States—

	Acres.
Mecklenburg-Schwerin	404,010
Mecklenburg-Strelitz	143,134
Oldenburg	110,639
Lübeck	7,479
Bremen	413
Hamburg	1,722
Total	667,396

Forest-area of Alsace-Lorraine.

	Hectares.	Reduced to acres.
Exclusively state-forests	133,811	320,512
Undivided state and other	17,995	44,448
Commune-woods	197,314	437,365
Endowments of institutions	2,215	5,471
Total	351,337	867,802

78. The following very instructive table is condensed from one prepared by Oberforstmeister Danckelmann, Academy-Director at Neustadt-Eberswalde, &c. It shows the kind of tree and the forest-management, the elevation at which it was produced, the formation and soil, the age, height in meters, contents in cubic meters, the number of trees standing upon each hectare, the contents in cubic meters per hectare, and the annual increment by the same measures.*

* *Op. cit. supra.*

Species.	Elevation in meters.	Rock and soil.	The stems.			The forest.			Place where grown.
			Age in years.	Height in meters.	Contents in cubic meters.	Number of trees per hectare.	Contents per hectare in cubic meters.	Annual increase per hectare in cubic meters.	
Oak, H*	Lowland	Diluvium sandy loam	170	30.1	3.78	372	732	4.3	Westphalia.
Oak, H	Lowland	Alluvial river-loam	120	26.3	3.35				Oderwald.
Oak, M	63	Diluvium loam	55	18	.44	756	411	7.47	Westphalia.
Oak, H	174	Clay-slate	200	25.7	3.72	440	486	2.43	Saarburg.
Oak, H	500	Clay-slate	75	19	.63	1,036	299	3.98	Königstein.
Beech, H	Lowland	Diluvium sandy loam	130	24.6	1.75	320	292	2.92	Mühlenbeck, Pomerania.
Beech, H	164	Jura	103	35	3.77	388	1,064	10.33	Springe.
Beech, H	300	Basalt	102	38	3.42	364	789	7.7	Coblenz.
Beech, H	500	Clay-slate	75	20.5	.60	1,036	299	3.98	Königstein.
Hornbeam, H	Lowland	Diluvium loam	112	21.9	.50	84	388.04	3.46	Astrawischpen.
Elm, H	Lowland	Alluvium river-loam	122	27.2	3.59	82 173	243	1.99	Peisterwitz.
Maple, H	Hilly land	Diluvium loam	110	22	1.53				Borken.
Maple, M	345	Musselkalk	96	23	1.00				Lohra.
Ash, H	Lowland	Alluvium sandy moor	100	25.5	2.061				Bönichen.
Birch, H	Lowland	Alluvium sandy moor	58	25.2	.42	1,680	172.8	2.98	Kurwien.
Birch, H	Lowland	Sandy loam	49	23	.603	716	204.24	4.168	Liepe.
Alder, N	Lowland	Alluvium sandy loam	53	22	.887	1,032	341	6.45	Liepe.
Alder, N	Lowland	Alluvium sandy moor	53	19	.553	1,616	216	4.07	Liepe.
Alder, N	Hilly land	Alluvial turfy	56	21	.31	800	247	4.41	Borken.
Scotch pine, H	Lowland	Diluvial sandy	105	26	1.491	460	384	3.657	Biesenthal.
Scotch pine, H	Lowland	Diluvium sandy loam	101	29	1.590	336	612	6.039	Liepe.
Scotch pine, H	Lowland	Alluvium turfy	96	15	.68	1,372	167	1.7	Stepenitz.
Scotch pine, H	Lowland	Diluvium sand	144	34.9	2.917	292	519	3.6	Cruttinnen.
Scotch pine, H	Lowland	Alluvial moor-sand	104	31.2	2.14	560	674	6.48	Poppslan.
Scotch pine, H	8 to 10	Alluvial sand-dunes	53	10.6	.08	680	133	2.5	Grünhaus.
Spruce, H	Lowland	Alluvium moor-sand	75	27.4	1.62	624	632	8.426	Proskau.
Spruce, H	260	Bunter sandstein	95	31	1.93	800	892	9.389	Grossera.
Spruce, H	314	Planerkalk	54	28.3	1.67	1,916	1,064	19.7	Böddeken.

* The capitals in the first column indicate the management. H., *Hochwald;* M., *Mittelwald;* N., *Niederwald.*

A view of the Prussian states' forests, showing their extent, the kind of trees, age, &c.

	Hectares.	Reduced to acres.
Total area	2,616,972	6,463,921
Pine and larch	1,371,405	3,087,370
Spruce and fir	261,015	644,707
Oak	129,450	319,741.5
Beech	398,735	884,875
Alder, birch, &c	98,741	243,891
Amount of *Hochwald*	2,259,346	5,380,315
Amount of *Mittelwald*	33,179	81,946
Amount of *Niederwald*	41,242	103,868
Oak-coppice	15,449	38,127
Pasture, (*Weidenheger*)	2,625	6,384
Age by classes:		
Over eighty years	548,969	1,343,953
Forty-one to eighty years	734,726	1,814,773
One to forty years	897,328	1,716,400

79. AUSTRIA.—The forests of Austria cover 1,606 square miles, or 33 per cent. of the productive surface. Compared to the population, this gives one acre of woodland to each inhabitant. But this is not evenly distributed, since the great body of woods is in the alpine regions of the south, and in the Carpathians, where the percentage is from 46 to 70, and the per capita is from 3 to 11 acres for each person. There is, indeed, in some regions a surplus, as in Galicia and Bukowina.

*Total productive forest-area of Austria.**

	Acres.
Lower Austria	1,381,250
Upper Austria	826,825
Salzburg	458,125
Tyrol and Vorarlberg	1,640,000
Styria	2,191,875
Carinthia	808,125
Carniola	933,125
Küstenland	396,750
Dalmatia	961,250
Bohemia	3,277,500
Moravia	1,258,125
Silesia	433,125
Galicia	4,450,000
Bukowina	984,375
Total	20,000,450

**Die Bodencultur Oesterreichs, im Auftrage des k. k. Ackerbau-Ministeriums, redigirt von Sectionsrath Dr. Jos. R. Lorenz and General-Domänen Inspector Josef Wessely. Wien.* 1873.

BY TERRITORIAL SUBDIVISIONS.

Alpine lands	7,393,250
Northwest land	5,663,625
Northeast land	5,434,000
Karst land	1,640,000

80. The following tables show for each of the provinces in the first column the area of forest-lands; the next, other productive property not wooded; then the sum of these; the next shows the amount of unproductive or waste; and the last, the total area of the crown and foundation estates of Austria. It has been collated and reduced to acres, from a comprehensive work on the agriculture of Austria, by Messrs. Lorenz and Wessely,* to the latter of whom, a jury-colleague, I am indebted for a copy.

The first table gives the figures for each of the several provinces; the second shows the proprietorship of the several foundations.

Crown and foundation lands of Austria.

	Forest-lands.	Other lands.	Total.	Unproductive.	Total.
Lower Austria	65,209	5,906	71,234	478	71,715
Upper Austria	159,792	16,440	176,282	83,172	269,455
Salzburg	203,899	22,516	264,915	152,110	430,525
Tyrol and Vorarlberg	299,246	31,260	330,506	359,009	680,515
Styria	126,240	26,464	154,954	54,069	206,522
Carinthia	44,415	9,153	56,317	9,477	65,791
Carniola	34,119	1,934	36,056	835	37,029
Coastland	31,728	2,519	34,246	311	34,557
Dalmatia	6,250	28,806	35,326	317	35,644
Bohemia	20,711	5,840	26,551	189	26,740
Galicia	481,873	28,746	510,349	14,377	524,726
Bukowina	481,500	81,645	563,145	8,019	571,164
Total	1,955,252	260,959	2,259,881	682,363	2,942,244
This area is divided as follows:					
The state	1,437,375	138,324	1,578,699	652,347	2,230,091
Church foundations	75,748	29,494	105,241	22,200	127,479
Greek church foundations	481,500	81,645	617,596	8,019	625,615
Students' foundations	10,150	9,557	19,683	34	18,716
Invalid foundations	3,130	.....	3,130	.....	3,130
Military academy foundations	1,416	356	1,772	.....	1,772

The imperial and endowment forest-property of Austria, with other estates, amounts to 1,371,311 hectares, as represented in a chart in the pavilion of the department of agriculture; of which extent 935,295 hectares, or 68 per cent., are productive forest-land; 123,170 hectares, or 9 per cent., farming-lands; and 312,846 hectares, or 23 per cent., are unproductive.† These possessions are scattered from the northern to the

* *Op. cit. supra.*

† For the valuable information contained in this section of the report, I am indebted largely to the "special catalogue" carefully prepared by my very agreeable colleague, Dr. Arthur Freiherr von Seekendorff, professor at Mariabrunn, the author of some standard works on forestry, a gentleman whose charming manners and many kindnesses to an unknown stranger from a far-off land quite captivated the recipient of his attentions.

southern boundary of the empire, in both Eastern and Western Austria, and they rise from the level of the Adriatic to the limit of vegetation in the alpine regions. Some of the alpine forests are still hampered with servitudes, though many of these have been released since 1853.*

81. ARCHDUCHY OF AUSTRIA BELOW THE ENNS—LOWER AUSTRIA.—In this province, we find the Wiener-Wald lying to the west and southwest of the imperial city of Vienna. It contains 26,677 hectares of woods, besides 1,200 of other lands; also near Neustadt, by the boundary of Hungary, is the so-called Kaiser-Wald, or Ofenbach forest, with 898 hectares of wood and 8 hectares of other lands; making in all 28,783 hectares, or 71,092 acres. The Wiener-Wald or forest has belonged to the Austrian government since the earliest times; but its economical importance dates from the latter part of the seventeenth century, and its management has culminated in a plentiful supply of wood and timber for the city, besides furnishing a charming resort for the citizens in summer time,—a grand park.

The surface is generally hilly or mountainous; the highest point, called Schopfel, is 893 meters, or 2,924 feet, above the sea-level. The soil of the Wiener-Wald is chiefly derived from the Wiener sandstone, with a mixture of finer and coarser masses of quartz; besides, in some of the districts, the Alpenkalk limestone is found. The Ofenbacher forest lies on schist, gneiss, and granite, with abundant pebbles from the mountains.

On the sandstone, generally, is found a clay soil, very favorable to the growth of trees, especially the beech. This changes according to the varying hardness of the sandstone, and the greater or less amount of lime it contains. A striking appearance is the frequent coming to the surface of the sandstone, especially on the north and northwest slopes. Above the limestone is a light and fertile soil, especially adapted to pines.

Deficieney of water is a characteristic of the Wiener-Wald. The principal river is the Wienfluss, which is liable to sudden floods at times of heavy rains.

Besides the Wienfluss, the Schwechatbach is to be mentioned as one of the most important, since it furnishes the chief water-way for transporting wood by means of dams or reservoirs, that are opened at intervals to flood the channel and carry the wood to its destination.

82. On the sandstone is a mixed wood-growth; the beech prevailing on the loamy soils. This is often the only tree, but is frequently mixed with firs and hornbeam, the common kinds of oak, Austrian and Scotch pine, and, in smaller quantities, spruce, ash, larch, elm, maple, birch, *Sorbus torminalis*, alder, aspen, and poplar.

The management is *Hochwald*, with a rotation of one hundred to one

* Some discrepancies may be noticed by the critical observer of these figures, which are given as they were found, presented by different authorities; but they do not materially invalidate the results.

hundred and twenty years. Near Weidlingau is a small portion of *Mittelwald* management, with a rotation of forty years. It is attached to the Forest School of Mariabrunn. The annual yield is 163,540 cubic meters from the chief product, and 33,390 cubic meters from the thinnings; together, 196,930 cubic meters, or 46,422 cords, chiefly fire-wood, about 5 per cent. only being utilized as timber.

The income for 1871 amounted to 1,131,754 florins, about	$565, 877
The expenditure	217, 368
Excess of income	348, 509

About $5 per acre.

The actual product, nevertheless, generally exceeds the estimated quantity by several thousand cubic meters, which is due to the improvement of the forests.

The valuable varieties of wood are divided into three principal groups:

The first group on the north and northeast, which lies between Kirling and the public road that passes through the Wien and Gablitz valleys, contains deciduous trees almost exclusively. These are principally beech, with more or less mixture of oak, hornbeam, ash, elm, maple, aspen, poplar, alder, &c.

To the second group belong the forests south of this road, with the exception of the Anninger and a part of the Kaltenberger reviers. Here, also, the beech prevails, though pines are mixed with it in varying proportions, so as even to preponderate in some places. In the more elevated situations of this group, the spruce and larch are found in natural growth.

On the limestone of the Anninger forest is the third group, composed of the native Austrian pine, mixed with the Scotch pine, (*Pinus sylvestris.*)

As regards the different modes of transportation, the forests of the Wiener-Wald are divided into *Achsforste*, which means where the wood is transported by land to its place of destination; and into *Schwemmforste*, from which it is transported by water to some point where it is either sold or sent on farther, by rail or otherwise. These *Schwemmforste* occupy 8,136 hectares, (four districts,) and the *Triftholz* amounts yearly to from 150,000 to 65,000 cubic meters of fire-wood.

The wood is chiefly sold by auction in the forests; most of it is consumed in Vienna, to which point it is carried by the West and South Railroads.

Incidental products.—Among these, the leaves are most important, and they yield relatively large products, amounting in the year 1872 to 6,129 florins 75 kreutzers.

Next to the leaves comes the resin from the Austrian pine. Besides these are the rents for wood-pastures, meadows, quarries, and for hunting, which last does not amount to much.

83. *Management.*—Since the new organization of the Austrian government forests, the management of the woods and domain in the Wiener-Wald is controlled by the minister of agriculture, under whom are also the Fonds forests and domain, situated in Lower Austria.

The forest-direction is made up as follows: one *Oberforstmeister*, two *Forstmeister*, one *Forstsekretär*, one *Oberforstingenieur*, one *Conceptsförster*, one *Rechnungsrath*, and various assistants.

The body of the real Wiener-Wald is divided into sixteen forest-districts, whose managers, with the title *Forst- und Domaenen-Verwalter*, are immediately under the direction.

For the protection of the forests, there are forty-eight *Forstwarte*, or guards, for the same number of districts.

84. The Wiener-Wald, being so near Vienna, afforded a good opportunity for studying Austrian forest-management, in which great assistance was rendered by the amiable and intelligent professors of the Mariabrunn Academy, who are very enthusiastic in the pursuit of forest-studies. Besides this, the Forest-Jury was favored with a pleasant excursion through some of the best and most interesting portions of the estate. This entertainment was given by the administration, and under the special guidance of Herr Robert Micklitz, *K. K. Oberlandesforstmeister*, (who was also a member of the jury,) accompanied by the Mariabrunn professors and the *Oberforstrath* of Austria. The occasion was a delightful one, and it afforded an opportunity of making observations under the most favorable circumstances, as the visitors were attended by the most intelligent *cicerones*, who were ready to answer all questions and to explain all difficulties. The whole trip was an example of the peripatetic forest-school.

As a means of conveying instruction, however, its only fault was, perhaps, that the course of study was too full for the time allotted to it. What might have occupied months was necessarily crowded into one day. But text-books were provided for us in the way of maps, and a full description of the *Wald*, especially prepared for the occasion, which have served an admirable purpose by enabling us to con over the details at leisure in our own homes.

85. The Students' Endowment Forest, at Grosspappen, contains 800 hectares of woods lying on the watershed of the Thaia River, about sixteen German miles northwest from Vienna. The surface is undulating, sometimes hilly, in part flat. Elevation from 500 to 600 meters. It is on the *Urgebirgsformation*, crystalline schist, mixed with gneiss, limestone, and granite. The soil a deep loamy clay. The climate is trying; the winters are long and snowy; the winds are often heavy, and hurricanes sometimes occur. All this requires the most careful planning of the clearings or culling of the timber. The principal kinds are spruce, fir, and Scotch pine, with birch, aspen, and linden. The rotation is one hundred years; the reproduction is by artificial planting. The annual yield is 4,680 cubic meters, of which, since the opening of the railroad, 50 per cent. is useful timber; the rest, fire-wood.

86. ARCHDUCHY OF AUSTRIA ABOVE THE ENNS RIVER—UPPER AUSTRIA.—The beautiful river, Enns, which furnishes a natural outlet for the rich products of the mines and forests of a part of the mountains of Styria, is also the eastern boundary of the province to which this part of my report refers; a region of varied surface, traversed by the Danube and drained by the Traun, the Salza, and other streams that flow from the snowy tops of the Austrian Alps.

This archduchy extends from the Enns to the Inn River.

The state-forest contains—

85,220 hectares of woods;
1,807 hectares cultivated ground;
61,262 hectares unproductive;

148,289 hectares, or 466,274 acres.

The Salzkammergut is famous for its salt-works, and also as a summer resort for the Viennoise, as well as for its forests.

Indeed, the leading motive for purchasing these possessions by the government was the preservation of the woods to furnish fuel for the imperial salt-works in the valley of the Traun. On the west, south, and east, the region is inclosed by the Alps of Salzburg, Styria, and Upper Austria.

87. With regard to situation, soil, and climate, the forests of the Salzkammergut may be divided into three regions: the first and largest of these is composed of the high mountains of limestone, which rear their mighty crests of unproductive lands, with rocks and precipices, on which only the *Pinus montana* is found.

The highest point of this group is the Dachstein, that raises its head, covered with eternal snow and ice, to an elevation of 8,900 feet, while the lowest is the surface of the Traunsee, that is 1,270 feet above the ocean-level.

Throughout this region, tree-growth is arrested at 1,510 meters, (4,945 feet,) and is confined to the valleys and sheltered places; where exposed and on the poorer soils, the trees are gnarled and twisted.

The next group embraces the foot-hills of clay-slate, and sandstone, of which the highest point is 1,074 meters, or 3,517 feet. The soil is not favorable for tree-growth.

The third group is level, of small extent, being the alluvial of the valleys; a sandy loam. The climate varies with this grouping. Snows fall early and abundantly, and in the spring they disappear very slowly.

Besides the mountain-streams flowing out by the Traun, which afford a convenient means of transport for the wood, the Salzkammergut is rich in lovely lakes of beautifully clear water, which lie embosomed among the mountains, and add to the beauty of the landscape, so that this region has well been called one of the most attractive in Europe. The largest of these lakes are the Halstättersee, the Wolfgangsee, the Mondsee, the Zellersee, the Attorsee, and the Traunsee.

The leading tree in the forests is the spruce; next to which are the beech, fir, and larch. Others, deciduous kinds, are scarce; but in cultivation, in the valley at Ischl, quite a number of American trees are growing well; among them the liriodendrons are remarkably fine. Near the town, a very thrifty chestnut was also seen.

Plenterbetrieb prevails, with rotation of one hundred and twenty years. Annual product is 230,840 cubic meters, or 7,714,739 cubic feet, natural reproduction; with little planting, on account of the shortness of the season.

88. THE ARCHDUCHY OF SALZBURG.—The state-forest here occupies an extent of 125,688 hectares of productive woodland, besides 250 hectares in farms and meadows, 2,296 hectares high pastures, and 5,870 hectares of alpine wastes; the whole property contains 134,104 hectares.

Most of the tract lies in the high mountains, composed of crystalline slates and gneiss, upon which lie grauwacke, sandstone, and alpenkalk.

Diluvial and alluvial formations are found in the valleys. The disintegration of the rocks has formed a rich, productive soil.

The climate varies: in the sheltered valleys, it is warm enough for the walnut, (*Juglans regia;*) on the more elevated places, and on the northerly and easterly slopes, the winter begins early, lasts longer, and has more snow. Long winters, short and cool springs, rainy summers, and warm falls characterize the climate.

89. The spruce constitutes the leading tree, alone or with fir, beech, and larch, a mixed, close forest, reaching a height of 1,600 meters, 5,244 feet. The highest wooded point is the Honikogel, 1,855 meters high; it is stocked with a beautiful dense forest of spruce. In the sheltered places, indeed, the spruce is found at a height of 1,900 meters, but the stems are short and small.

The fir does not occur massed by itself, but mixed with spruce and beech; nor does it reach so high as the spruce, seldom exceeding 1,300 meters. Fine specimens of the beech are rarely found so high. On the northern slopes of the Tannengebirg and on the west slopes of the Stuhlgebirg, at a height of 1,600 meters, the beech occurs in masses with the *Pinus pumilis;* the stems, however, are gnarled and short.

The larch is usually mixed with other trees. Clear patches are of small extent. It is found in all situations, but prefers the north and east slopes, and reaches the height of 1,906 meters.

The Scotch pine is seldom seen except in dry and hungry soils, and seldom over 1,450 meters in elevation.

The Swiss stone-pine is found in many valleys quite abundant, sometimes in fine stems. In a good situation, handsome trees may be found at 1,900 meters; but its favorite locality is between 1,450 and 1,750 meters above the sea, where it is found in small compact groups.

The *Pinus pumilio* occurs on all the high mountain-tops, and reaches to 2,200 meters in sheltered places.

The common alder is found in the valleys by the streams, occasionally rising to 1,300 meters.

Maple, ash, elm, birch, oak, &c., are not sufficiently numerous to be of much importance, and they generally stand singly.

In some of the lower altitudes, with deep, rich soil, we find here and there a wood of remarkable beauty and with an abundant growth that would yield 600 to 650 cubic meters per hectare. In this region, the harvesting of the forest is done by clean clearing (*Kahlhiebè*) of the entire side of a valley.

The product of 1871 consisted of—

	Cubic meters.
Fire-wood	108,880
Coal-wood	17,030
Logs	5,150
Total	131,060

Most of this is consumed at the salines of Hallein. The charcoal goes to the furnaces and founderies.

90. KINGDOM OF BOHEMIA.—The Joachimsthaler forest lies near the boundary of Saxony on the Erzgebirg. It contains 5,616 hectares, and lies from 900 to 1,000 meters above the level of the North Sea. Consequently, these elevations, combined with their northern position, have on their summits a severe climate, which is milder and the vegetation more promising only in the sheltered valleys. The angle of incidence of the sun's rays on various slopes and mountain-tops falls between 20° and 40°. The soil consists of clays and the *detritus* of schist and granite; and, in consequence of abundant precipitation, it is usually moist and well adapted to vegetation.

91. The leading forest-trees are the spruce, with some firs, and occasionally beech and larch.

The forest-management is high timber, (*Hochwald*,) and the annual yield is:

	Cubic meters.
First quality	15,036
Inferior	1,232
Total	16,268

92. THE DUKEDOM OF BUKOWINA.—The area of the Eastern Greek church endowment amounts, in round numbers, to 230,240 hectares, or forty German square miles = 568,693 acres, divided into five districts. This property is scattered in larger or smaller tracts over the whole of the crown-lands of Bukowina. Some is among cultivated lands; the rest lies on the high Carpathians.

Among the usual species, the spruce occupies the first place, next comes the fir, and then beech. Oaks are only found in favorable situations. In the lower lands are the ash, maple, elm, alder, linden, &c., and, where introduced artificially, the larch and Scotch pine. On the heights, at elevations of from 1,650 to 1,850 meters, the *Pinus pumilio* and *Pinus uliginosa* are found.

The proportions of woods are represented by spruce, 50; fir, 23; beech, 20; oak, 1.5; ash, maple, elm, alder, linden, birch, aspen, and willow, 1.5 in 100.

The chief forests are *Hochwald*, with a rotation or term of from eighty to one hundred and twenty years. The reproduction of the woods is chiefly natural, by self-seeding; but some planting is done from nurseries.

Ship-timbers are an important product. They are floated on the Bistritz and Dorna to Galatz on the Lower Danube. The mainmasts are from 26 to 32 meters long by 57 to 68 centimeters thick. The mizzen-masts are from 47 to 55 meters long by 47 to 55 centimeters diameter. The foremasts are from 24 to 28 meters long by 36 to 44 centimeters thick. The yards are from 19 to 23 meters long by 21 to 36 centimeters thick. Beams are from 13 to 19 meters long by 16 to 19 centimeters thick at the upper end. The annual product equals 556,738 cubic meters, or 18,606,143 cubic feet.

To offset this abstraction, the calculated increase by growth in the same districts amounts to 1,338,050 cubic meters, or 45,817,631 cubic feet, so that only about one-third part is utilized.

93. Kingdom of Galicia.—The state and endowment forests are comprised in nine divisions, which have a total area equaling 229,182 hectares, or 556,079 acres, of forest, and 40,530 acres of farming-land. Of this, the state holds 438,250 acres of the former, and 24,402 acres of the latter; the rest is endowment-land. (*Fondsbesitz.*)

In the sandy lands, the Scotch pine is the chief tree; on better and loamy soils, the oak comes in with fir and beech, birch, &c.

Of all these divisions, that of *Bolechow* and *Dolina* furnish the best example of a Galician forest. It is a mountain-region, with broad levels on the summits, and in the elevated valleys, which are from 650 meters to 1,600 meters above the sea-level. The lower slopes have deciduous trees, mixed with the conifers; the latter, chiefly spruce, in the higher grounds, are of remarkably fine quality.

94. Earldom of Göritz and the Margraviate of Istria.—*The Coast-land forests.*—In his report upon the plans for reforesting this region, M. Scharnagll says* that perhaps in no part of the Austrian empire, with the exception of Dalmatia, is the forest so much reduced as in the Küstenland, nor does any other country suffer so much from the consequences of this scarcity of woods as these provinces; because of their southern position, and of the prevailing limestone rocks, they require especially a permanent forest for the preservation of the earth moisture.

It is well known that the deforesting of this territory is the cause of the severe drought and the consequent scarcity of pasture and bad crops. The impoverishment of the land is referable to natural causes.

In consequence of its mild climate, and of its being accessible to the

* "*Kartbewaldung*," *von Simon Scharnagll, Forstinspector in Triest.*

markets of all the great states, this was one of the richest lands of Europe in the times of the Romans.

Within a few years, the reforesting of this extensive, desolate, and really unprofitable Karstland has been undertaken in earnest, as will appear from the report of the contents of the nurseries to supply the plantations.

The total extent of the Küstenland amounts to 1,385,476 joch = 1,731,845 acres.

95. An intelligent writer from this country, who was met at the forest congress to which he refers, gives the following graphic description of the region under consideration:

"Immediately after leaving Triest, the train passes through miles and miles of the most barren, rocky mountain-scenery that it is possible to imagine. It seems as if some terrible curse hangs over these miles and miles of hills, literally covered with stones; even shrubs being scarcely able to take root among the rocks. Five hundred years ago, as an intelligent gentleman informs me, all these hills were covered with grand old forest-trees, of which, however, none remained at the end of the last century.

"The Venetians had been in the habit of sending their galleys to this coast, bordering as it does on the Adriatic, to fetch all the wood they needed, until they had finally completely deforested the entire region. So it remained for centuries, and the hills having lost their protectors, the soil was washed away by the storms, leaving the bare rocks, on which no vegetation could cling.

"Thus the vast stony wilderness remained until some twenty years ago, when the attention of the Austrian government was called to the matter, and eminent economists were confident that the waste district could eventually be reclaimed and restored to its former usefulness.

"The Austrian government then caused miles and miles of olive-trees to be planted among the rocks, although first of all the very soil had to be carried to the roots of the trees.

"The young trees took root, but at first suffered severely for lack of moisture, since it had been noticed that with the destruction of the forests the rain-fall had constantly diminished, until finally scarcely any fell during the hot summer months.

"By and by a pleasant verdure again covered the hills, and the clouds took compassion on the gasping plants as they passed over them; for it is a fact that whereas heretofore rain scarcely ever fell upon the barren hill-sides, now it falls in sufficient quantity, and a pleasant climate will soon return to the once barren district. The phenomena here related are by no means isolated in the history of deforested districts. They have been observed at Cairo and in other countries.

"I think it well to call attention here to the fact that one of the most important international congresses to be held at Vienna during the

Exposition will be devoted, on the one part, to the question of forest-culture.

"The great chemist Liebig, whose death at Munich occurred a few days ago, spoke once to me on this very subject. He expressed the view that the decay of ancient empires—of Greece and Rome—was due, more or less, to the neglect of the peoples to take care of the land and its fertilizer and climate-regulator, the forest."—(Correspondence New York Herald.)

96. In 1872, the following plants were in the central seeding-nurseries of conifers: such as Austrian pine, white pine, maritima, Aleppo pine, pinaster, stone-pine, spruce, larch; at Rodik were 3,682,500, of which 1,150,000 were ready for planting; at Capo d'Istria, 211,000, of which 73,500 were ready to set; at Göritz were 15,930 ready to plant; altogether ready for planting in 1873, 1,239,000.

Of deciduous trees: such as robinia, Norway maple, sycamore-maple, field-maple, box-elder, beech, hornbeam, ash, *Fraxinus ornus*, alder, *Quercus pedunculata, pubescens*, and *suber*, (cork,) horse-chestnut, linden, field-elm, *Ulmus effusa*, *Laburnum*, *Gleditschia*, *Catalpa*, &c. Of these there were at Rodik 810 not yet ready to plant; at Capo d'Istria, 1,351,600, of which 338,000 were ready for planting; at Göritz, 4,891,200, of which 3,872,000 were ready—total, 4,210,000 ready to set out in the year 1873. Besides which there were 660,500 nut and fruit trees, of which 486,700 could be planted—total plants, 10,817,741.*

M. Scharnagll gives in tabulated form, representing all the above-named varieties, the number of young trees that have been sent out from the nurseries for planting up to the autumn of 1872. Without going into the details of the proportion of conifers and deciduous forest and fruit trees, the grand total is here presented: for planting in the Karst, 1,019,945; sold to other provinces, 1,740,500.

Total of plants produced by these nuseries:

Conifers	3,909,466
Deciduous	6,247,676
Fruit and nut trees	660,599
Total	10,817,741

97. Dukedom of Carinthia.—The state and endowment forests lie in the western part, and extend from the levels of the valleys to the alpine heights as far as forest-vegetation is possible. They are drained by the Drave and its numerous branches.

The area of the four districts amounts to 42,481 acres, which, with the sterile alpine heights, makes a total of 53,948 acres. With deep and long valleys separated by high mountains, this is essentially an alpine region. The servitudes of wood, litter, and pasturage make a heavy drain upon these possessions.

* Scharnagll.

On the foot-hills, the forests consist chiefly of conifers, spruce, fir, Scotch pine, and larch, with deciduous trees, such as beech, hornbeam, alder, poplar, maple, and birch, scattered through them. The land is well stocked, and the trees make a good healthy growth. Their harvesting generally occurs by clearing entirely, (*Schlagweise,*) and the management is *Plenterbetrieb*, with a rotation of eighty years.

In the higher grounds, the deciduous trees give place to the conifers, spruce, fir, and larch. The Swiss pine (*Pinus cembra*) appears in the central alpine chain, in the highest timber-region, mixed with stunted spruce and larch, as warders of the highest forest-production. These forests, which are seldom more than 1,700 meters high, and from their being scattered, and with their rugged character, it is assumed that they generally have a rotation of one hundred to one hundred and twenty years.

98. Dukedom of Carniola.—The state-forests of Carniola are divided into five districts, which cover 12,167 hectares, or 30,052 acres. The imperial forest of Idria is from 300 to 1,300 meters above the sea. The rotation is one hundred to one hundred and twenty years, with either the entire clearing or gradual cutting. The area is 7,735 hectares. The yearly production is 28,078 cubic meters.

The mountain-forest of *Lanczowa-Illoucze* is an elevated plateau of square form. The highest point is 1,400 meters, and still within the line of wood-vegetation; the soil is rich in humus. The woods are made up of spruce and fir, with some beech on the northerly slopes. The rotation is eighty years, and the annual yield is 4,422 cubic meters from an area of 1,863 hectares.

99. Archduchy of Styria.—The Neuberg-Mariazel state-forest contains 33,493 hectares forest; 7,796 hectares productive land; 4,246 hectares unproductive land; total, 45,535 hectares, lying in the forest-region, and extending in part into the alpine heights. The surface is all mountainous. In the Neuberg-Wald spruce and fir are the most numerous, about 60 per cent.; next, larch in mixture, 20 per cent.; then follow the Scotch pine and beech, and a small amount of maple, birch, and alder. In the alpine region the *Pinus pumilis* abounds.

In the Mariazel district, spruce is the most frequent and important tree, mingled with larch. In the deeper and more sheltered places, the fir bears itself well, and the birch and *Alnus incana* assume importance. The management is altogether high timber, (*Hochwald.*)

The state-forests in Tyrol and Vorarlberg cover a space of 138,115 hectares, besides 196 hectares of endowment-lands. These are still much hampered by servitudes, in spite of the efforts to free them. These amount annually to an abstraction of timber and lumber, about 7,581 cubic meters; fire-wood, 45,489 cubic meters; litter and brush, 40,435 cubic meters; pasture of about 74,000 head of cattle, horses, and mules, and about 22,000 sheep and goats. The forests are chiefly stocked with conifers, and have a rotation of one hundred to one hun-

dred and sixty years. They lie from 650 to 1,960 meters above the sea. In the valleys, the rotation is twenty years.

The leading trees are spruce, fir, Scotch pine, larch, cembra pine, beech, *Alnus incana*, yew, *Pinus pumilio*, and *Pinus obliqua*. The proximate yield is 238,082 cubic meters. Resonance-boards of superior quality are prepared here. Excepting some small reviers in the valley of the Inn, the management of the forests is chiefly *Hochwald*, and this is mostly cut by *Kahlhieb*, (clean cutting.) So far as appears, the *Plenterbetrieb* prevails. The felling is done from spring to fall. Coaling is largely carried on. After the clearing, the reproduction is chiefly effected by plantations, which permit a choice of kinds and proper admixture. The larch is highly esteemed, and its increase is thus secured. In 1870, there were 150 nurseries of young trees.

100. HUNGARY.—Of the total area, being 32,988,795 acres, the forests cover 9,082,434 acres, of which, according to the minister of finance, the state-forests compose more than one-half, or 4,383,244 acres,* from which it appears that rather more than one-fourth of the territory is wooded, and yet there are extensive tracts of open country, resembling the steppes of Asia, and devoted to agriculture and pasturage.

101. The following tables convey much information as to the kind of forest, their productiveness, and relative area compared with the total of the different provinces of the kingdom.

In Hungary, we find the relative distribution of forest-lands as follows:†

Provinces.	Forest area.	Total area.
	Acres.	*Acres.*
Presburg	2, 183, 505	6, 216, 496
Buda-Pesth	770, 506	6, 659, 703
Odenburg	1, 888, 259	6, 949, 780
Kaschau	2, 844, 920	6, 539, 952
Grasswardein	1, 395, 144	6, 622, 863
Totals	9, 082, 334	32, 988, 794

The next table shows the area and the annual production of the Hungarian state-forests, with the several species by which it is furnished.

Annual product of each species in normal klafter of 100 *cubic feet.*

Area in acres	4, 373, 241
Spruce	499, 540
Fir	259, 848
Scotch pine	570
Oak, (*Q. robur*)	357, 470
Quercus cerris	27, 490
Beech	1, 350, 940

* *Statistische Daten aus den ungarischen Staatsforsten, Budapest*, 1873.

† *Lorenz and Wessely.*

Hornbeam	10,122
Ash and elm	49,360
Poplar, birch, and willows	21,630
Chestnut	4,600

Making a grand total of 2,581,570,000 cubic feet of lumber; the annual product of 4,373,241 acres of forest,* at the rate of 590.31 cubic feet per acre annually.

Pinus austriacus, *Pinus cembra*, maples, and larch, &c., are found mixed with the others in small quantities.

102. The endowment-forests of the Hungarian kingdom are scattered widely, in many pieces, and in several parts of the country, especially on the Carpathians. Mr. Alexander Hoffmann furnished a sketch of these estates, showing their extent and the quantity of their annual production.†

The area of these forests amounts to 101,536 joch, equal to 126,920 acres, of which 27,100 acres belong to the university; 27,311 acres to students' endowment; 68,850 acres to religious institutions; and 3,681 acres to vacant church-property.

In regard to the surface, these forests have 39 per cent. flat-rolling or low land, 36 per cent. moderately mountainous, and 25 per cent. of quite mountainous land.

As to species, they produce 8 per cent. of conifers, 3 per cent. of soft-wooded deciduous trees, and 89 per cent. of hard woods. 48 per cent. is *Hochwald*, 52 per cent. *Niederwald*. The rotation is one hundred and twenty years on 4 per cent., one hundred years on 10 per cent., sixty years on 6 per cent., forty years on 4 per cent., thirty years on 2 per cent., twenty-five years on 2 per cent., and fifteen years on 1 per cent. of the whole area.

Of the product, 19 per cent. is in timber, 25 per cent. lumber, 55 per cent. fire-wood, and 1 per cent. bast from the linden. Of the fire-wood, 2 per cent. is yielded by the coppices; from this, the tan-bark has been stripped.

103. EGYPT.—Though not by any means a timbered country, Egypt has an extensive sylva of native and introduced trees, among which are those from a wide range of latitude.

The ornamental and forest trees embrace the *Acacia nilotica*, which is quite common in Egypt and the Upper Nile, sometimes forming forests. It is planted along the irrigating canals. This tree yields the gum-arabic of commerce. The wood produces charcoal, and is used for agricultural implements.‡

**Statistische Daten aus den ungarischen Staatsforsten, Verlag des kön.-ung. Finanz-Ministeriums, Buda-Pesth*, 1873.

†*Die Productionsverhältnisse der königlich-ungarischen Fondsdomänen-Forste, verfasst von Alexander Hoffmann, k. u. F. D. Forstmeister, etc., Karte, 10 veilagen, Buda-Pesth*, 1873.

‡*Siemoni, vide ante.*

Pinus halepensis.—This magnificent conifer is adapted to the warm climate of Egypt. Large trees are to be seen about Cairo. The wood is valuable for building. The Casuarina, from Mauritius, is a tall tree, that was introduced in the reign of Mehemet Ali. About Cairo are plants 60 and 70 feet high. It also succeeds well on the sands of the Isthmus of Suez. There are already large specimens at Ismaïlia.

The "American oak"* has been naturalized in Egypt, and succeeds at Cairo. There are large specimens at the Garden of Choubiak, which fruit annually, and thus this valuable tree is being rapidly increased.

The *Cocos flexuosa*, a palm from the tropics, has been introduced, grows vigorously, and makes a beautiful tree.

The *Tamarix orientalis* reaches a height of 45 feet. It is planted along the roads and as shelter-belts against the sands of the desert The wood is used for charcoal.

The *Robinia pseudo-acacia* does not seem to thrive well, and makes only a low tree, cultivated in gardens as an ornamental for its fragrant flowers.

Several trees are grown for cabinet-making and for use in the arts. Among these are the *Acacia melanoxylon* and the *Dalbergia melanoxylon*, native of the Upper Nile; have been introduced into Egypt about Cairo; the wood of the latter is beautiful and useful.

The *Santalum album* about Cairo attains a good size; flowers and fruits every year. The wood is esteemed on account of its agreeable odor, to make fancy articles, and for carving.

The *Cedula odorata* has been introduced to a limited extent in the gardens of the viceroy. The wood is known as cedar and is used for cigar-boxes.

The *Swietenia mahogani*, a tall tree of fine foliage, was introduced in the reign of Mehemet Ali, and has already attained the size of the largest trees of the country. It is not yet disseminated, and is found only about Cairo.

Cupressus pyramidalis, *Fraxinus*, *Chloroxylon*, *Diospyros*, and other naturalized species, are used by the cabinet-makers.

The *Acacia lebbek* is an elegant tree of persistent foliage, planted along the roads and avenues; the heart-wood is black like ebony, and is used for agricultural implements.

The *Tectona grandis*, the teak, with its large and beautiful leaves, will be very ornamental for avenues when more largely propagated; the value of its timber in naval architecture is well known.

The *Ficus bengalensis*, the banyan or pagoda tree, has a large multiplex stem, formed of the adventitious roots united together, and enlarging the trunk.

The *Platanus orientalis* has been planted in the gardens of Cairo and Alexandria; the wood is valuable.

The famous *Eucalyptus globulus* was introduced some years ago by

* The species I have not identified.

Gastinel Bey, and, with some other species from Australia, succeeds well.

Among the poplars, our own *P. canadensis* is highly esteemed. Other American plants that have been successfully introduced are the *Catalpa*, valued for its blossoms, and the *Magnolia grandiflora*.*

104. Dr. Charles Beke, in the Athenæum, writes from Cairo, June 24, 1874, that there were 2,500,000 trees in cultivation in 1860, and now 5,000,000 had been planted. He found trees along the road, and planted so extensively as to give the appearance of a well-wooded country.

Already, there seems to be a change of climate as a consequence of the increased tillage and forest-culture. He says, "Egypt is fast losing its proverbial rainless character;" rain has begun to be felt an annoyance at Alexandria, and is markedly increasing at Cairo, where Dr. Beke enjoyed "four-and-twenty hours of rain, as heavy and continuous as any in London; in fact, a regular English wet day."

105. ALGERIA.—The forests cover 1,440,000 hectares, of which 800,000 belong to the state. The rest is held by private individuals, by the communes, or remain as commons, (*terres de párcours.*) The portion covered with the wild olive has been assigned to cultivation.

The following statement, taken from the special catalogue of the products of Algeria prepared for the minister of the interior of France for the Universal Exposition at Vienna, 1873, shows the characters of several kinds of woods, and the area occupied by each:

Cork-oak, (*Quercus suber*)	797,203
Chestnut-leaved oak, (*Quercus castaneifolia*)	98,568
Aleppo pine, (*Pinus halepensis*)	496,964
Cedar, (*Cedrus atlantica*)	788,570
Quercus ilex, var. *ballotta*	249,435
Thuja	133,101
Elms, ash, willow, poplar, tamarix	8,640
Evergreen oak	1,298,726
Wild olive	74,578
Bushes, various kinds	220,023

The leading products of these forests which enter into trade are cork, timbers, worked lumber, such as parquetry, resins, and tanning-materials. Of cork, it is estimated that the eastern portion of Algeria contains as much as all the rest of the world, and of superior quality. In 1872, the export of cork amounted to 5,426 tons.

The different species of oaks furnish the building-timbers. The *Quercus ilex* and the *Q. Mirbeckii* are the most valued. The latter is superior in density and strength to the oaks of Europe. So, also, the *Q. castaneifolia* furnishes excellent lumber for ship-building and other

* For the items of this section, I am indebted to the admirable "Catalogue raisonné" of an agreeable jury-colleague, M. Dilchevalerie, Directeur de l'École Vice-Royale d'Agriculture de Caire, etc.

purposes. The holm-oak (*Quercus ilex*) and the *Mirbeckii* (Zeen) could be used to advantage in the manufacture of furniture.

The cedar is equally adapted to joinery and for building. When used for the lining of furniture, the odor prevents the inroads of insects. The wood of the southern ash (*Fraxinus australis*) is superior in beauty and quality to the ash of Europe, so much esteemed by wagon and carriage makers.

The Aleppo pine (*Pinus halepensis*) rises to a height of 60 feet; might supply the deal which France buys from other lands.

The Thuja, *Callitris quadrivalvis*, has an established reputation. Furniture made from the knots is wonderfully beautiful and universally admired. The olive (*Olea europæa*) is very common. It is used in the preparation of choice furniture, and also in carriage-making.

The *Ceratonia siliqua* and the *Pistacia atlantica* are also very suitable for the cabinet-maker. The latter is especially adapted for cog-wheels. The other woods used in cabinet-work and for inlaying are the Phœnician juniper; for boxes, the jujube; the lemon especially for fancy-work; and pipes are made from the roots of broom.

But it is not yet sufficiently known how important a part is to be played in this branch of manufactures by the *Quercus ilex*, var. *ballotta*, which is spread over the surface of 100,000 hectares in Algeria, where it acquires a great size. The wood is of a beautiful deep red, black at the heart, with brilliant layers of fine and close grain; taking a most perfect polish, retaining the varnish, it must become prominent in the manufacture of furniture for dining-rooms and libraries, for wainscoting, and for parquetry.

106. FRENCH COLONIES.—GUIANA.—Guiana is one of the richest countries in the world in woods for cabinet-work, for building, and for wagons. Certain species possess elasticity and durability in a remarkable degree, as will appear from the following table:

Kinds of wood.	Comparative numbers, oak as a unit.		Loss of strength after lying six months in the dung-heap, (*Fumier.*)
	Elasticity.	Resistance to fracture.	
			Per cent.
Common oak, France	1.000	1.000	0.35½
Teak, superior quality	2.000	1.920	0.16½
Tender, India	1.000	1.330	0.25
Angelique	2.250	1.820	0.05
Coupi	1.760	1.660	0.0
violet	2.250	2.650	0.0
Wacapou	2.000	2.000	0.0
Walata	3.325	3.150	0.10
Courbaril	4.000	2.825	0.12½
Taoub	2.008	2.000	0.31¾
St. Martin	2.000	2.325	0.11¾
Black cedar	1.820	2.325	0.235
Beech, injected in France	1.420	1.100	0.30
Poplar, injected	0.665	0.830	0.10

French Guiana extends from the river Maroni to the Amazon, and measures about 72,000 kilometers. The interior is covered with extensive forests. Angelica-wood is considered superior to teak for the broadsides of sheathed vessels; it rates high in the preceding table.

107. MARTINIQUE contains about 20,000 hectares of wood suitable for building, cabinet-ware, and wagon-making, but the means of transportation are deficient, so that the most valuable materials are often reduced to charcoal with little profit.

108. GUADELOUPE, one of the Lesser Antilles.—The forests cover the mountainous parts of the island to the extent of 40,724 hectares, which produce abundantly of material that is admirable for cabinet-ware, though as yet it is little utilized. There are also many species well adapted to carpentry and other arts. The timber should be cut in January or August, and immediately stripped of the bark and split through the heart.

109. SENEGAL.—This country does not produce any considerable quantity of wood, though some of its shores are covered with *Acacia Adansonii*, suitable for ship-building; but this is not the case with the French station at the mouth of the river Casamanza, on the west coast of Africa, whose forestal resources are immense.

Besides Senegal, France has other possessions on the west coast of Africa, among which are Gaboon, under the equator, and establishments on the Gold-Coast. The forests of Gaboon are very rich, but are little used. The export of sandal-wood and ebony amounts to 25,000 tons annually.

110. NEW CALEDONIA is in great part covered with forests containing woods well adapted to cabinet-work and wagon-making.

111. OCEANICA.—The woods of Tahiti and its dependencies contain few species, which are only used in the country. Several kinds have been introduced from other lands.

CHAPTER IV.

ESTATES OF LANDED PROPRIETORS.

THE VIENNA JOINT-STOCK COMPANY; FOREST-AREA; TOPOGRAPHY; CLIMATE; FLORA ADMINISTRATION.

112. THE VIENNA JOINT-STOCK COMPANY FOR FOREST-INDUSTRY.—This company made an exhibit of the productions from their extensive estates in Lower Austria, situated near Waidhofen, on the Ipps River, at Gaming, and in other smaller tracts.

The possessions cover 27,330 hectares, of which 24,907 hectares are in forest. This property is situated in the mountainous parts of Lower Austria, extending from Zellerhütten, near Mariazell, in the east, along the Alpine range which forms the border of Styria, to the line which separates Upper from Lower Austria. Of course, much of the surface is very elevated, and the mountain-peaks are nearly 6,000 feet above the level of the Adriatic sea. The valleys are high; the market-town of Scheibbs being 1,046 feet, and other places are higher, till you reach Neuhaus, which is 3,168 feet above the sea. The slopes are sharp and steep, and cliffs rise in abrupt precipices.

The Ipps and the Erlaff flow for many miles through the estate. The former from Neuhaus, below Zellerhut, flows seventeen miles to its confluence with the Danube at Stadt Ipps, with a very rapid descent; the total fall from the source to the Danube being 3,526 feet.

113. *Climate.*—In the valleys, spring opens in April, while the snow continues to cover the mountains, where the pastures can seldom be used before the 25th of June, nor later than the 29th of September. The first snows fall in the mountains in the middle of September; but in the valleys they do not occur until the middle of November, or even as late as December.

At Waidhofen, they have 108 rainy days and 30.5 snowy, yielding 32.6 inches of rain and 67 inches of snow. They have 21 days that are perfectly clear.

Forest-vegetation seldom begins earlier than May 15 on the mountains, when the snow is often from 6 to 12 feet in depth, forming drifts of from 20 to 30 feet, and often remaining until July and even till August. Snow and sleet frequently damage the trees quite seriously. The heaving of the soil with repeated thawing and freezing, particularly where exposed to the sun, injures the young trees, so that it is often difficult to reproduce the forest in such places. This is the explanation of the great difference observed in the appearance of the forests between

the shady and the sunny sides of the mountains. The southern slopes, with all possible care, will often remain bare, while on the shaded sides the clearings reproduce their growth in spite of the browsing of the cattle.

Elevations of forest-growths.

	Lower, feet.	Upper, feet.
Pines	.....	2,200
Beech	.....	3,000
Fir	.....	3,000
Larch	1,000	3,200
Spruce	1,000	4,500
Mountain-pine	2,000	5,500

The pines (*sylvestris*) are found on the southwest and south sides; the beech usually on the east and northeast; the fir is found highest on the southwest, south, and southeast; the larch is found higher on the north and northeast slopes than on the southerly or westerly exposures; the spruce reaches its greatest elevation on the western, southwestern, and southeastern situations; the mountain-pine is found at its highest limits on the southwesterly, westerly, and southerly exposures.

Among the trees, the larch is especially the species for the high mountains and for northern exposures; its elasticity and its strong roots enable it to withstand the wind-storms; a stony but humose soil is suited to it, and particularly the limestone formations. For the first twenty years, the larch grows rapidly, but afterward the spruce overtops it. In a forest of eighty years old, the larches will have an average diameter of 12 to 18 inches, while the spruce measures only from 9 to 12 inches.

The excellence of the larch timber is well known and universally admitted, and may be rated as equal in value to oak. The influence of the situation upon the quality, however, is greater than with other kinds of trees. The mountaineers are so well aware of this that they speak of the *joch*, the *grass*, and the *stone larches*. The *joch*-(field-) larch has a dark-red wood which is soft and brittle, with little power of resistance, and is the least durable. The grass-larch from the lowest part of its native zone, grown on firm soil, has small rings of growth, a pale yellow-brown color, and rates in value with the spruce. The stone-larch bears the palm, and, when grown in its favorite mountain home, it has decidedly yellow-brown wood, with strong, dark, and hard rings, and in this character it supplies the place of oak to the alpine people.

The fir is not particularly desirable in these mountains. It is branching and knotty, so that the boards are inferior. It is rarely found alone, but usually mixed with beech.

114. *Forest-management.*—On these estates, natural reproduction is the rule. Conifers abound, hence the *Hochwald* prevails almost exclusively. The beech seeds itself more frequently than other trees, and

comes naturally in places suitable to it; but this is not objected to, as the wood is valued, especially for fuel and for coaling.

Artificial reproduction is practiced where the natural process is unsatisfactory or slow. It has many advantages, especially in the mountains, in its quicker and more satisfactory results.

The sunny side is not favorable for the seed-beds. The young plants may thrive the first year; but he who expected to find them in good condition the following spring would be disappointed, for they would be heaved out of the ground by the repeated freezing and thawing. Besides, the sun's rays fall too directly upon these slopes for the successful germination of the seeds; hence the shady side is preferred. This is shown us by nature's indications; the intelligent forester will observe that he finds most young plants in a clearing sheltered by the stumps and large stones, where they are protected from the direct rays of the sun, from the sharp winds, and drowning floods, as well as from the tramping of cattle at pasture. These indications should be our guide in the selection of the site for the nursery of seedlings, and this method of stump-seeding deserves consideration on all the exposures of the high mountains. Therefore, when any elevated tracts have to be planted, the reproduction will be quick and certain if this hint be observed and followed.

In alpine regions, there is another practice which has proved very satisfactory; this consists in burning over the clearing: the rubbish is gathered and burned, and one or two crops of grain are taken, or, where grain will not ripen, at least a cattle-fodder-crop may be cut from this fallow ground. Good rye has been grown at an elevation of 3,500 feet on these burned tracts, and the poor woodman is thus rewarded for his labor. A light sowing of forest-tree seeds with the grain is often followed by good results. The intelligent forester will select the method he thinks best adapted to the circumstances by which he is surrounded. Sometimes he may even prefer the "hill-planting," which consists in setting the little tree upon the surface of the ground and piling mellow earth about its roots; this is practiced in wet and boggy lands.

Tuft-planting, three or more in a place, is found to furnish security from both sun and frost; nor are these bunches so apt to be damaged by the browsing of game as trees set out singly, and they shade the ground sooner, which is a matter of great importance, as it encourages the rapid growth which is desired by every forester.

It is, however, a mistake to plant too thickly in the high mountains; the trees should be at least six feet apart, to give room for the snow, which might smother them. Thick sowing and close planting are liable to suffer beneath the snow-drifts, especially on mountain-slopes which lie to the west and north, where the snow accumulates in great quantities. Nor can the same regularity be maintained in setting out as in the level country.

Instead of extensive nurseries, as practiced in the lowlands, the mount-

ain foresters have smaller patches, at convenient distances from the land to be planted; these are called seed-camps, (*Saat-Kampen*,) and obviate the necessity of laborious transportation, at the risk of exposing the roots of the seedlings. For this purpose, a small level place of from 20 to 30 quadrat-klafte (say 100 square yards) is selected; from this the stones and roots are cleared off, the grass and rubbish burned, and the soil stirred in the fall. Next spring, the seed is sowed in rows from 12 to 18 inches apart, and must be protected from birds, mice, and insects.

In the fall, the plants must be covered with moss. Cultivation is begun after the snow has disappeared and the weather is settled; but it is unwise to begin operations too early, lest the germinating seeds be nipped by late frosts. The sowing should not be done till the nights are warm, when they will quickly germinate; and the plants do best if the seed be sown in the month of May or early in June. The transplanting may be done even after the young shoots have appeared, but care in handling the young trees is necessary.

These points, of the situation of the estate, and the practical management of the forests, with much other detail respecting the business of the company, are contained in a brochure which accompanied their extensive exhibition of material at the Exposition. It is called "Die Ausstellung der österreichischen Actien-Gesellschaft für Forst-Industrie in Wien auf der Wiener Welt-Ausstellung, 1873. Verfasst von der Forst-Direction."

115. SCHWARZENBERG FORESTS AT WITTINGAU.—The following memoranda show how carefully the forests on some of the estates have been guarded for centuries.

These are selected because opportunity was afforded for observing parts of the Schwarzenberg domains, and they can be taken as samples of others which may be quite as good.

In the basement of the family-mansion at Wittingau, in Bohemia, was a large fire-proof room, filled with archives embracing a history for the centuries that this property has been in the possession of the family of its present princely owners.

In many respects, this was an exceedingly interesting collection; but for our present purpose it was particularly valuable for the accounts of the forests and other improvements of the lands.

From these archives, it appears that even in the fourteenth century a careful oversight of the forests was exercised.

With the increase of the people, the forest-master found it necessary to regulate the forestal privileges and pasturing; to determine the boundaries of the forest-range; to charge them with rents; and to sell off pieces of woodland so as to reduce the soil to cultivated fields.

The first notice of wood-sales is given in 1409, when it is stated that 20 schock of groschen were paid to the Wittingau official for wood.

In 1523, the woods were divided into separate districts, or tracts, and most of the names then applied still serve to designate the reviers, or divisions, of the forest-land.

Measures for the preservation and melioration of the forests began to be taken at the end of the seventeenth century. At the same time, certain pieces of wood were cleared and turned into farms and meadows. The wood was mostly burned and the ashes sold. The drainage of the morasses near Wittingau and Borkowitz was also begun at this time.

The oak was a great favorite with Prince John Adolf the First, and it appears that he ordered the people "to plant acorns in inclosures, to transplant the young trees at four and five years old, and to establish fine oak-woods." Being well aware that this would require time, he exhorted them to go on with the work; "though the trees would not reach perfection for many years, let not this discourage you, but remember that we are working for posterity rather than for the present generation."

The numerous magnificent and beautiful oak-trees now to be seen at Wittingau are the living and silently eloquent witnesses of the correctness and wisdom of the views contained in these citations from the family-archives.

In 1703, the woodlands of this estate were divided into seven tracts, or circles, (*Reviers.*)

From 1715 to 1730, new forest-ordinances were issued; goats were forbidden to pasture in the woods, and young trees were not allowed to be cut.

In 1748, it was ordered that no more May-poles should be cut, and birch-saplings were no longer to be taken for the celebration of the holiday of Corpus Christi.

In 1769, the authorities directed that the forests should not only be strictly preserved, but that they should also be carefully nursed and cultivated or encouraged.

With this view, experiments were then first made in the use of turf for fuel; and, as this substance abounds in the extensive morasses, these wastes began to be drained for tree-planting in 1776 to 1783.

In the beginning of the present century, thorough surveys and descriptions were made, and the boundaries were definitely settled by practical engineers.

The drainage near Wittingau was carried on vigorously, so as completely to change the character of the soil and its productions in the morasses of Hrolorezer, Borer, and Gratzner. Next followed the drainage of Borkowitz, with the preparation of the turf for fuel. It is remarkable that none of these improvements were required by a scarcity of wood, but they were conducted for the sake of the future betterment of the forests. There was then no systematic utilization of the forest-products, and there was an abundance of fuel because of the limited demand which was long felt.

A demand had to be provided; except the glass-house at Sachenthal, there was no market for wood within reach.

In 1830, attempts were made to encourage other similar establishments; but they failed on account of deficient means of transportation.

The water-ways to reach a more distant market with the wood required great outlays for their improvement. When these were opened, dealers were attracted, and a large trade was opened for the products of these well-preserved woodlands; and from that time the cultivation and management of the forests have been perfected and brought up to the standard of the best modern practice.

116. The forest-area now amounts to 25,688 joch, 32,110 acres of wood land, and 1,007 joch of clear or cultivated soil.

The annual increase is rather more than three-fourths of a klafter per joch, equal to 52 cubic feet, or 3.4 cubic meters per hectare.

As to the land, the subsoil has sand, gravel, and clay, with some lime and iron, so that the water of the marshy places is obnoxious to vegetation. The top-soil is in great part boggy and peaty; the rest is sand, sandy clay, and stony clay, a tertiary formation.

These varieties of soil are accompanied by a great difference in the growth and species of trees, which is especially the case in the boggy land, particularly where it has been meliorated by exposure to the air, so that there is an advance in the annual yield from nothing to two klafter per joch.

The poorest growth is found on hungry sand, and on deep, boggy soils that are not drained, or insufficiently drained, while the best growth occurs on the drained and improved bogs and on deep, humose clays.

On the large bogs, not yet drained, and where it has not been possible to introduce improved forestry, the *Pinus uliginosa** is the leading product.

The surface is generally level, except near the Moldau. The plains are higher to the west, where they form the water-shed between the Moldau and the Luschnitz.

Most of the trees are conifers, and chiefly the Scotch pine. The planting of oaks has greatly increased in the recent decades, wherever the soil is suitable. The bog-pine (*Pinus uliginosa* or *mugho*) is abundant in the swamps. It differs from the sprawling *Pinus montana* in its erect growth, and from the *sylvestris* in its compact habit. Though a small tree, it is useful. The swamp-birch (*Betula pubescens*) abounds in the marshy lands, and is short-lived.

Next to the bog-pine comes the common pine, at first mixed, then alone, or nearly so. This species is found on the thinner portions, where the bog soil is not so deep.

The Scotch pines are not so large nor so thrifty as in some other soils, but some portions look well and furnish good logs; the trees grow high enough, but are not large.

The spruce and oaks are not found on the marshy tracts; but the latter grow very well on the higher flats of the bottoms of the Alsbach, which are occasionally overflowed.

The sandy ridges, poor in humus, produce only a slender growth of the pine, while upon them the oaks never reach perfection; but on deep

* *P. mugho*, Banhin, or *P. uliginosa*, of Wimmer.

sandy land, well supplied with humus, the spruce, pine, and oak form very fine forests, in which also are found beech and linden, and occasional aspens and birches are to be seen doing well.

The stony loams are the favorite localities for the spruce-trees, which are planted alone, and produce ship-timbers. The *Quercus sessiliflora* is the favorite oak, and predominates, producing tall stems without branches or knots when they are planted with pines; but it does not compare in size or strength with the common form, (*Quercus pedunculata*,) which requires more space, and, branching lower, gives less length of log; both kinds are produced on the plains about Wittingau.

During an excursion of the Bohemian Forest Society to these estates in 1863, the following measurements were taken:

Oaks measured at Wittingau in 1863.

Diameter in inches.	Height in meters.	Contents.	
		Cubic klafter.	Cubic feet.
96	26.46	24	1,663
102	.....	25½	1,767
72	.....	16	1,108.8
84	.....	19	1,316.7

Among the injurious climatic agencies affecting these forests, the northwesterly, westerly, and southerly winds are most dreaded by the foresters; for not infrequently trees are destroyed in a few minutes even in sheltered or protected woods. The frosts often seriously injure the roots of the young trees. Insects, also, are injurious; the pine-moth (*Tortrix dorsana*) is frequently seen; beetles are troublesome, small and large; the May-bug and the mole-cricket are common; and the oaks are affected by the *Tortrix viridana* and the *Cerambyx heros*.

The Saxon system of management has been adopted, and at Wittingau the forests are divided, according to their age, into—

Classes.	Age.	Proportion.
I	From 1 to 20 years	16.3
II	From 21 to 40 years	19.2
III	From 41 to 60 years	17.8
IV	From 61 to 80 years	14.8
V	From 81 to 100 years	17.2
VI	Over 100 years	14.7
		100.0

Of these, 19 per cent. belong to the first three classes; 56 per cent. to the fourth; and 25 per cent. to the fifth and sixth classes.

The forest-territory is divided into 17 reviers; of these, Hrdlorez, Schloss, Cep, Kollenetz, and Wall are adjacent, and comprise a forest-complex of 19,093 joch, or 23,866 acres, extending from the south to the north, along the eastern boundary of the demesne. The reviers are subdivided into regular sections of similar area for the convenience of their cultivation, management, felling, &c. The forests are surveyed

every ten years, and the portions to be successively cut are then indicated.

117. ESTATES IN BOHEMIA.—The following notices of the general tenure of lands in Bohemia, and especially of some large estates, will give an idea of the care with which the forests are guarded by the landed proprietors.

The tables, and indeed all the facts, have been taken from a pamphlet accompanying the collective exhibition by the kingdom of Bohemia, made at the Vienna Exposition. It was prepared by A. E. Ritter von Komers.*

Tenure.	Agricultural.	Forest.	Unproductive.	Total.
Feudal	1, 387, 116	2, 276, 764	156, 735	3, 822, 610
"Rustical"	6, 670, 390	615, 580	189, 645	7, 463, 015
Total acres	8, 057, 506	2, 892, 344	346, 380	11, 285, 625

The total of the feudal properties, 3,822,610 acres, is divided among 1,086 estates. Of these, 350 hold less than 1,250 acres; 212 have from 1,250 to 6,250 acres; 53 have from 6,250 to 12,500 acres; 33 have from 12,500 to 25,000 acres; 14 have from 25,000 to 37,500 acres; 5 have from 37,500 to 50,000 acres; 5 have from 50,000 to 62,500 acres; 4 have from 62,500 to 75,000 acres; 3 have from 75,000 to 81,250 acres; 1 has from 81,250 to 87,500 acres; 1 holds over 87,500 acres.

On the other hand, there are estates graded in regard to size, as follows: 552 places of less than 1,250 acres; 360 places of from 1,250 to 6,250 acres; 108 places of from 6,250 to 12,500 acres; 50 places of from 12,500 to 25,000 acres; 7 places of from 25,000 to 37,500 acres; 5 places of from 37,500 to 50,000 acres; 1 place of from 50,000 to 56,250 acres; 1 place of from 56,250 to 62,500 acres; 2 places of more than 62,500 acres.

The following shows the number of estates held by the land-holders: There are 536 persons who hold but one estate; 69 hold two estates; 23 hold three estates; 21 hold four estates; 7 hold five estates; 8 hold six estates; 5 hold seven estates; 4 hold eight estates; 4 hold nine estates; 3 hold ten estates; and 1 holds more than ten properties. A few of these domains will be mentioned more in detail.

118. Count Franz Thun's domain embraces—

Tetschen	25, 189 acres.
Freehold Perac	4, 264 acres.
Freehold Gros Zdikau	11, 201 acres.
Freehold Skalicz and others	605 acres.
Total	41, 259 acres.

**Skizzen über die Verwaltungs-Organization von Grossgrundbesitz-Complexen in Böhmen.—Als Beitrag zur land- und forstwirthschaftlichen Collectiv-Ausstellung des Königreiches Böhmen auf der Welt-Ausstellung in Wien*, 1873. *Prag*, 1873.

119. *Tetschen.*—Of this, the forests cover 19,140 acres, and most of this is an area of 17,347 acres, bounded on the east by the Elbe; the rest is scatted in parcels over the estate. These woods are divided into ten reviers.

The formation is quaternary sandstone, with some basalt. The surface of the great forest is mainly composed of slopes to the north, south, and southeast. The soil on the sandstone is somewhat stony, on a sandy loam, with sufficient humus in the valleys. On the basaltic rocks, it is stony but rich. Since the elevation is from 350 to 2,300 feet above the sea, the climate is favorable, in the lower parts adapted to deciduous trees, but on the elevations only spruces are produced. Conifers are the leading sorts, chiefly the spruce alone or mixed with firs, pines, and beech of various ages.

The Scotch pine is next to the spruce in respect to numbers. It grows both mixed and in masses by itself, especially on the dry, sandy southerly slopes near Tetschen. The fir is seen only in the valleys in scattered groups, especially on the basaltic soils; the larch and *Pinus strobus* appear in small patches.

Beech is most numerous among the deciduous trees, and is not only found in a liberal mixture with the spruce, but also in extensive woods alone in some of the reviers. There is not much oak, maple, nor ash; but care is now taken to increase these kinds where they will not be injured by game. The rotation is usually about one hundred years. The reproduction is commonly that following a clean cut, either natural growth or by seeding.

Classification.—A portion is divided as follows as to age:

Classes.	Years.	Acres.
I	1 to 20	3,288
II	21 to 40	2,235
III	41 to 60	2,439
IV	61 to 80	3,784
V	81 to 100	3,736

About 185 acres are felled annually, yielding a total of 17,025 klafter, or 1,123,650 cubic feet, being an average of 6.074 cubic feet per acre.

The lumber is mostly sold to dealers, who take it by the Elbe; and much of the fire-wood goes to market in the same way. The inferior wood and the stumps and roots are made into charcoal for the Saxon iron-works.

The production may be divided thus: soft woods—lumber, 71.6 per cent.; fire-wood, 28.4 per cent.; hard woods—lumber, 18.6 per cent.; fire-wood, 81.4 per cent.

Annual production.—Ship-timbers, 25,872 cubic feet; building-timbers, 201,432 cubic feet: tan-bark, spruce, 22,968 cubic feet. Each acre of a clearing will average, if spruce, fir, and beech, of one hundred and fifteen years, 17,417 cubic feet: if Scotch pine, at seventy-five years, 3,365 cubic feet.

120. *Forest-culture.*—Since 1785, surface-drainage by open ditches has been extensively carried on. Since 1830, 48,000 running-klafter have been dug.

Planting and seeding are both practiced; in the former, the plants are grown in home nurseries, and set out at one and two years old; latterly, good results have followed from transplanting spruces at one year. As a rule, the planting is in rows; on good soil, the rows are 6 feet wide and the plants set 3 feet apart; on thinner soils, the rows are 5 feet apart and the plants from 2 to 2½ feet apart. The seed rows, or beds, are from 18 inches to 2 feet wide; and the plants should stand from 4 to 4½ inches apart.

The annual planting amounts on the average to 175 acres, consisting of conifers from 450,000 to 500,000; deciduous kinds, 12,000 to 14,000; seeds sown annually, 350 to 400 pounds.

These forests are damaged by the game gnawing and peeling, by the *Curculio pini*, and by snows and sleet, as well as by occasional storms of wind.

In January, 1834, 42,625 trees were prostrated; also, in 1868, there was a widely-extended storm in Bohemia that destroyed 4,194,515 cubic feet of wood in this forest.

Fishery.—Within the forest, there are nine ponds and mill-dams for the saw-mills, where trout are bred in large numbers; these fish abound also in the brooks.

121. *Peruc.*—This estate has been enlarged by successive additions within the present century. The forests are not large, and are divided into two reviers; a part is *Hochwald*, with eighty years rotation; part *Mittelwald*, with thirty years; and part *Niederwald*.

Species grown: chiefly the Scotch pine, and oak; then spruce, beech, larch, and birch mixed together.

122. *Gros Zdikau.*—This extends westwardly to the bounds of Bavaria, joining the state-forests; eastward and southward it joins the estate Winterberg, (Schwarzenberg's.) The elevation is considerable, and the mountains form the water-shed between the North Sea and the Black Sea; the Moldau descending to the one and the Daunbe to the other. The mountains rise to more than 4,000 feet.

Gneiss abounds, and the soil is good, a stony loam; but the climate is unfavorable; the winters are long and severe; the summers cool, so that vegetation often suffers from late frosts and from the early approach of winter; snows do considerable damage. The storm of December, 1868, destroyed 30,000 klafter of wood, and that of October, 1870, 90,000 klafter.* Spruce is the leading forest-tree on these elevations; fir and beech, however, take a very prominent rank. The Scotch pine is seen only about Gros Zdikau, mixed with spruce and fir; the mountain-pine is found on the high moors. Maple, ash, birch, aspen, &c., are occasional.

* A cubic klafter is equal to 66 cubic feet, rather more than half a cord.

Age-classification.

Class.	Years.	Acres.	Estimate.
			Cubic feet.
I	1 to 20	2, 562	807, 840
II	21 to 40	1, 185	1, 414, 320
III	41 to 60	1, 928	4, 271, 160
IV	61 to 80	725	2, 380, 140
V	81 to 100	286	1, 118, 100
VI	Over 100	2, 289	14, 733, 300
		1, 030	552, 300
Totals		10, 005	25, 277, 160
Besides from scattered trees			48, 000
			25, 325, 160

Under the present management, with a rotation of one hundred years and a clearing of 72 acres annually, the product should amount to 522,000 cubic feet. The proportions are: Of soft wood, timber, 39 per cent.; fire-wood, 61 per cent.; of hard wood, timber, 34.3 per cent.; fire-wood, 65.7 per cent. Of the timber, nearly 3 per cent. is made into resonance-boards; the mass of fire-wood is used by the glass-houses, which consume more than three thousand cords annually. A large quantity of stump-wood is made into charcoal.

The reproduction is chiefly done by planting, a small part by seed; the plants are set 6 feet by 3 in rows. In the decennial 1866 to 1875 they are planting 153 acres each year, using about 2,150,000 plants, and 6,000 pounds of seed; of these, the largest proportion is spruce.

The nurseries occupy $3\frac{1}{4}$ acres, and furnish 400,000 two-year old plants annually.

123. *Skaliez.*—The freehold of Skaliez, lying near Zdikau, was purchased in 1862 by the present proprietor, for the sake of clearing off some troublesome servitudes on his other possessions.

The surface is mountainous: it lies chiefly on the right bank of the Volinka, and, being so near the Boehmerwald, the climate is raw, except in sheltered valleys. The rock is gneiss and lime, and the soil tolerably good, according to elevation, better below; from 7 to 12 inches cultivable or surface soil.

There is not much forest, about 75 acres of *Hochwald*, chiefly Scotch pine, with some spruce and larch.

124. Count Rudolf Chotek's Possessions.—These embrace:

Weltrus	10, 680	metzen	5	mssln.
Neuhof	19, 059	"	3	"
Kĕlošic	3, 143	"	13	"
Total	32, 884	"	5	"

125. *Weltrus.*—The forests are divided into three reviers. The soil is sandy to loamy in different parts, and adapted to deciduous trees; a portion of one of the reviers is appropriated to the park, where oaks

prevail, partly alone and partly mixed with ash, maple, poplar, birch, and locust.

In the other reviers, the Scotch pine prevails, either alone or mixed with spruce.

There are 950 metzen *Hochwald*, 444 park, 335 coppice-wood, and 42 bushes and waste, (*Remisen.*)

The amount to be cut annually is fixed at 440 klafter, or 29,040 cubic feet. The planting in the park is with five and six year old deciduous trees; in other reviers, with one and two year transplanted conifers from the nurseries.

126. *Neuhof.*—The forests are divided into seven reviers; the soil is loose sand, varying to a productive loam.

The Scotch pine prevails; in some reviers alone; in others mixed with spruce, oak, and birch.

The pine reaches its perfection on the higher grounds in eighty and in lower places in sixty years.

In the total area of 2,650 acres, 2,125 is *Hochwald;* 197, coppice; 107.5, unproductive; deer-park, 195; aviary for pheasants, 25 acres.

The rotation is eighty and sixty years for the *Hochwald*, and thirty years for the coppice.

The annual production is limited to 2,137 klafter. The reproduction is effected by planting, and large trees are set to avoid damage by the game; these are grown in the nurseries.

127. *Bělošic.*—The forest-area of this estate amounts to 265 metzen, (7 miles,) of which but a small part is in conifers; it is chiefly oak-coppice, with a term of twenty years.

The yearly product is about 2,600 cubic feet, or 37½ cubic feet per acre.

128. Count Theodore Thun-Hohenstein's estate Choltitz.—This embraces, in farms, meadows, lakes, and forest, 6,055 acres. A portion, which is on the boundary between Bohemia and Moravia, is mountainous; the lower parts have a rich alluvium, stretching northward to the Elbe.

The hedge-rows and the plantations, beside the ponds and the wooded slopes, give the whole a park-like aspect. The forest is divided into four reviers; in all, 2,467 acres, chiefly *Hochwald*, in which fir is most abundant; next spruce and pine, then oak, and less birch. Home nurseries supply plants for the reproduction of the forests.

129. Prince Max Egan Fürstenberg's domain Pürglitz.—Lying westward from Prague, this large estate of 84,125 acres has 66,750 acres in forest, divided into 25 reviers. A large portion of this was natural production of the previous century. Beech occupies the greatest extent, partly mixed with fir; then oak.

In some reviers, the forest is chiefly oak; in others, fir. Scotch pine comes naturally in the oak-woods. Spruce was a stranger here, but, in

later years, it is much extended; next to spruce and fir comes the pine, alone and mixed.

Within fifty years, the larch has been introduced with good success.

Among the deciduous trees, the beech, hornbeam, and oak are most common. Some birch and aspen are found. Maple, oak, elm, linden, and mountain-ash occur on the hilly places; alder, in the valleys. The forest may be divided thus: *Hochwald*, with spruce and fir, 34 per cent.; pine and larch, 33 per cent.; mixed deciduous and conifers, 18 per cent.; all deciduous, 13 per cent.; coppice, 2 per cent.

The oak succeeds remarkably well, alone, and mixed with beech and fir.

In 1867, the reckoning of the forest gave the following classes by age: Over 100 years, 7.8 per cent.; from 80 to 100 years, 7.4 per cent.; from 60 to 80 years, 12.2 per cent.; from 40 to 60 years, 18.5 per cent.; from 20 to 40 years, 18.1 per cent.; from 1 to 20 years, 28.6 per cent.; unoccupied and cleared, 7.4 per cent.

The average estimates of all these periods:

Hochwald.	Klafter.	Acres.
Fir and spruce	2,066,480	22,776
Pine and larch	1,670,215	21,149
Mixed deciduous and conifers	787,795	12,437
Deciduous	617,270	8,801
Coppice-wood	118,415	1,307
	5,260,175	66,470

130. *Forest-culture.*—The spruce is largely planted; next come the pine, larch, and deciduous trees, of which class are oak, maple, ash, alder, elm, and locust. In the last three years, an average of 1,812 acres have been planted with—

Spruce, two to three years old, nursery	3,400,000
Pines, one year old, from seed-bed	1,300,000
Larch, two to three years, nursery	560,000
Deciduous, three to six years, nursery	250,000
Total	5,510,000

Seeds sown in open ground, in rows, and seed-beds: fir, 40 hundred-weight; pine, 10 hundred-weight; fir, 200 metzen, (pecks;) acorns, 100 metzen; beech-nuts, 50 metzen; various deciduous, 20 metzen.

The seed-beds and nurseries cover thirty-two and a half acres.

There were used at the sowing 20 hundred-weight spruce; 10 hundred-weight pine; 5 hundred-weight larch; 50 hundred-weight deciduous seeds.

Four million and two hundred thousand seedlings are annually transplanted in the nurseries; and the average number of plants on hand is 12,000,000.

131. Property of A. E. Ritter von Komers, Mostau.—Situated near Eger, and on the Eger River, not far from the western border of

Bohemia. The surface is various, being in the valleys and on the hillsides; so also the soil varies from a rich alluvium to sandy loam, underlaid by rock and clays, the latter of fine quality for pottery. The estate covers 965 acres, of which 302 are woodland.

The forests had been cleared off, and are now being reproduced with great care. Fir and spruce are the favorites, and, on poorer land, birch, pine, and larch are cultivated.

The plantations are being made chiefly on the clearings of the former woods. On the whole property, there is not a rod unfit for other crops that is not to be occupied by trees. Thirty thousand plants, large and small, are set yearly from the nursery, which has an average of 80,000 plants, and 15,000 more are purchased.

A hasty survey of these estates is all that can be given, and, indeed, all that could be obtained in a rapid transit by rail through parts of some of these properties; but the figures are reliable, and are given on the authority of A. E. Ritter von Komers, the Counsellor and Central Director of Estates for Bohemia.

CHAPTER V.

FOREST-SCHOOLS.

GENERAL ORGANIZATION OF SCHOOLS OF FORESTRY; GERMAN EMPIRE; PRUSSIA, BAVARIA, SAXON, WÜRTEMBERG, BRUNSWICK, SAXE-WEIMAR, HESSE-DARMSTADT, BADEN; MINOR SCHOOLS; AUSTRIAN EMPIRE; SCHOOLS ESTABLISHED BY THE STATE; MARIENBRUNN, WEISSWASSER, ENTENBERG, KREUZ, HINTERBRUHL; OTHER EUROPEAN SCHOOLS.

132. FOREST-SCHOOLS.—Forestry is considered so important an interest in most parts of Europe that especial attention has been bestowed to advancing the proficiency of those who are to be engaged in the care of this branch of agriculture. Forest-schools have been organized in various countries, and sylviculture is taught in the agricultural schools. A brief notice of some of these establishments will now be given, so far, at least, as they were brought to my notice by the Exposition and its associations.

133. GERMAN EMPIRE.—Here, as might have been anticipated, the greatest attention has been paid to this kind of instruction.

In *Prussia*, there are two important forest-schools, one at Münden, the other at Neustadt-Eberswalde. The latter was founded in 1821, under the care of Alexander Humboldt. It has been presided over by Pfeil, by Grünert, and more recently by Dankelmann.

Here is situated the chief forest meteorological station of all Germany.

The course occupies two years and a half. There are a director and two professors, one of whom conducts the labors of the experimental station. Then there are a professor of natural sciences, with his assistant, a superintendent of the physico-chemical station, a teacher of zoology, a professor of botany, one of geology, one of mathematics and of jurisprudence, and finally one of architecture: making eight professors. This academy costs the state 12,500 thaler, equal to about $9,375 annually.

Captain Walker, in his report,* refers to the admirable museum connected with this school. It is now under the care of Prof. Dr. Altum, the successor of the distinguished entomologist and author, Ratzeburg,† its founder. "It is rich in specimens of all sorts of birds, animals, and insects found in the forests, very neatly arranged. In case the animal or insect damages the tree, specimens of the branch, bark,

* Report of Forest Management of Germany, Austria, and Great Britain, by Capt. Campbell Walker, F. R. G. S., deputy conservator of Forests. Madras, India.

† *Die Waldverderber und ihre Feinde, oder Beschreiburg und Abbildung der schädlichsten Forstinsecten und der übrigen schädlichen Waldthiere, etc., von Dr. J. T. C. Ratzeburg, Prof. Naturwissenschaft, Neustadt-Eberswalde. Berlin.*

leaf, root, or cone, both in a healthy state and injured, are exhibited together, so that the student can see at a glance the nature of the damage, and connect it with the animal that causes it. Insects are shown in the several stages of their existence—larva, chrysalis, caterpillar, moth—with their erosions of the leaves, branches, stems, and bark of the trees."

The school at Münden, in Hanover, was opened in 1866, having a director, with several professors and assistants.

The programme of instruction is like that at Neustadt-Eberswalde.

134. *Bavaria* has its famous "Central Forest Institute" at Aschaffenburg, founded in 1807, suppressed in 1832, and re-opened in 1844.* Its course embraces two years and a half. Its director, Mr. Stumpf, has associated with him five professors. The annual expenditure is about $12,000, (24,000 florins.)

This is the source of the valuable labors of Dr. Ernst Ebermayer on the Physical Influences of the Forests on the Earth and Air,† a book which analyzes the results of all the meteorological forest-stations o Bavaria.

There are also subordinate schools in Bavaria at Weihenstephan, and at Lichtenhof, near Nuremberg, where forestry is taught.

135. *Saxony* has its famous Forest Academy of Tharandt, of which the distinguished Dr. Judeich is now the worthy director.‡ This institution was privately founded in 1811 by the distinguished Henry Cotte, and became a government-school in 1816. The course embraces two years and a half, and its *personnel* consists of the director and four professors, with two assistants. The annual cost amounts to about $9,000.

136. At Hohenheim, in *Würtemberg*, well known as the famous school of agriculture, in 1820, two chairs of forestry were founded.

137. In *Brunswick*, at the College Carolina, there are also two chairs of forestry. The course occupies two years.

138. In the *Grand Duchy of Saxe-Weimar* is a forest institute, at Eisenach, with three professors. The scholastic term occupies one year and a half.

139. At Giessen, in *Hesse-Darmstadt*, the university has had two chairs of forestry since 1825, with a course of three years.

140. The *Grand Duchy of Baden* has erected two chairs since 1832 for teaching forestry at the Polytechnic at Carlsruhe, where the course is four years.

141. Most academies teach the principles of forestry, besides which there are numerous experimental stations.§

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* Baierische Central-Forst-Lehranstalt in Aschaffenburg.

† *Die physicalischen Einwirkungen des Waldes auf Luft und Boden und seine klimatologische und hygienische Bedeutung*, von Dr. Ernst Ebermayer, Professor der Agriculturchemie, Geognosie und Bodenkunde, in der Central-Forst-Lehranstalt, Aschaffenburg, 1873.

‡ Herr Dr. Judeich was president of the jury that examined the exhibitions of forestry at Vienua.

§ For further information, the reader is referred to *Deutscher Forst- und Jagd-Kalender*, 1874, or to the *Allgemeine Forst-Jagd-Zeitung*, 1873.

In Germany, there are also many private associations in the interest of forestry, among which may be named the Association of Agriculture and Forestry, (Tedeschi,) established in 1837, at Dresden; a similar society at Heilbronn, in Würtemberg, founded in 1839; the Silesian Association at Gorkau, founded in 1841; the Forestal Company of the Harz, in Ballensted, founded in 1848.

The Society of Hils-Sollins is another such association, which published a bulletin in 1853.

The Forestry Association of the Palatinate of the Rhine, established in 1854; that of Saxony, founded in 1851; that of Baden, created in 1839, but re-organized in 1861.

The Society of Thuringia in 1870, and that of Gotha in 1854.*

142. AUSTRIAN EMPIRE.—In Austria and its dependencies, there are also many establishments where instruction in forestry is given more or less thoroughly; but it was to be observed that many of the leading foresters of that empire were either Germans or had pursued their studies at the celebrated and long-established schools of that country.

As there are extensive forests in Austria, it was natural that the government should have long ago established schools for the preparation of the officers under whose care they were to be placed.

143. One of the first was the Forest School of Mariabrunn near Vienna, established in an old monastery, in 1813, by Emperor Franz Joseph. This was re-organized in 1867, and has since been in a flourishing condition, with extensive museums, laboratories, a nursery, with the neighboring Wiener-Wald, for illustration, and a corps of excellent and devoted professors. The course covers three years. By a decree of April, 1872, this is to be united with the Agricultural College of Vienna, which is to have two sessions, one agricultural and one forestal. The new organization was to have gone into effect in October, 1874.

144. After personal inspection, I can indorse what Capt. Campbell Walker says of Mariabrunn:

"The museums and collections are particularly fine and interesting to the forester, especially the sections known as the 'Forst-Betrieb' and 'Ingenieur's Museum.' In the former are collected specimens of all instruments and appliances made use of in felling, squaring, sawing, carting, and preparing timber; models of saw-mills and machinery of all descriptions, from the rude and simple apparatus of former centuries, still in use in some of the remote mountain-forests, to the more effective, but at the same time more complicated, methods of modern times.

"Here, also, are plans of river-beds, improved and embanked for floating, models of sluices of all sorts, of dams and weirs for directing rafts in their course, and for catching the fire-wood which is floated in billets; accurate models of the rafts themselves, showing exactly how they are constructed; specimens of timber of all sorts, prepared in various ways.

* Siemoni, p. 35.

"The damage done by animals and insects to timber-trees is also exhibited here in a comprehensive manner."*

145. The Forest School of Weisswasser was founded in Bohemia in 1855. The course occupied two years.

146. In Entenberg, near Sternberg, is a middle forest school, established in 1852. In 1872, it had 42 pupils. The course continues two years.

A school was established by the state at Kreuz in 1860, called the Agricultural and Forestal Institute, with a three-years' course and five professors.

There is an elementary school of forestry and arboriculture at Hinterbruhl, near Vienna, founded in 1865, for training foresters practically. Another like it, at Schneeberg, was established in 1869.

Besides the chair of forestal science at the Polytechnic at Prague, there is one at the Technic Institute of Brünn, and that of Lemberg, in Galicia, one at the Academy of Mountain Affairs (*Montanistica*) at Leoben, and others have been established at Pibramm in Bohemia, at the Agricultural Institute of Tetschen in Bohemia, and at Grossau in Lower Austria.

147. In *Hungary*, also, there are forest-schools; one at Schemnitz was started in 1852, which is maintained at an annual expense of $9,500.

The Austro-Hungarian empire also has many organized companies and societies in the interest of forestry, which must aid its progress; among these are: the Forestry Society of the Austrian empire, founded in 1852; that of Tyrol and Vorarlberg, re-organized in 1852, by fusion of the society of the South with that of North Tyrol, the association above the Enns existing since 1854; the Forestry Association of Manhartsberg in Lower Austria; the Vienna Joint-Stock Company for Forestry at Waidhofen on the Ipps, noticed in another portion of this report; and the Actien-Gesellschaft für Haupt-Industrie of the Innerberg, with its extensive domains of mines and forests on the borders of Styria, are among those which attracted attention.

Besides these are the Forestry Company of Styria and Carinthia, established in 1851; the Association of Moravia and Bohemia, since 1849; that of Moravia and Silesia, founded in 1845; the Society of Western Galicia, in 1850, at Cracow; and the Hungarian Forest Company at Gran, in 1851.

148. SWITZERLAND.—The confederation of the cantons established the Polytechnic School at Zürich in 1855. This embraces the following divisions: a school of building and architecture; one of mechanics; one of chemistry; one of civil engineering; and one of forestry.† They have also a society of forestry, that prepared the articles and superintended the display of the forest-products of Switzerland at Vienna.

* Report of Forest Management in Germany, Austria, and Great Britain, by Capt. Campbell Walker, F. R. G. S., deputy conservator of forests, Madras, London.

† *Catalogue de la Section Suisse de l'Exposition Universelle à Vienne*, 1873, page 30.

149. ITALY.—In Italy, instruction in forestry has of late years been introduced.

The Forest Institute of Vallambrosa has been established, with a meteorological station, under the care of Professor Bechi, well furnished with the best instruments.

Other stations have been organized at Florence, at Genoa, at Turin, at Aquila, and at Cuneo.

From the first, large numbers of plants of conifers have already been distributed for planting.

150. FRANCE.—France has an institute for forestry, founded in 1824, at Nancy. Besides the director, there are ten professors. The course embraces two years.

For the education of subaltern foresters, there is an inferior forest-school at Grenoble and another at Villers-Cotterets.*

151. RUSSIA.—Russia, with her immense extent of forest-lands, has an imperial forestry institute at St. Petersburg, founded in 1813, improved in 1828 and 1833; it is known as the Forest School of Lissino. The number of pupils has reached 600, and of professors 66.

There is another forest-school at the village of Stor-Evois, with director and three professors, and a two-years' course.

A chair of forestry has also been established at the Institutes of Kalazin, Wologda, Lipetsk, at Marymont in Poland, and at Mitau.

At Grodno and at Moscow there are schools for the instruction of the under-foresters and guards.

152. SWEDEN AND NORWAY.†—A forest-school was established in Sweden in 1828, with a director and four professors. The course embraces two years. Besides this, there are, in different parts of the kingdom, four private forest-schools aided by government, and a chair of forestry in the agricultural school of Afra; also five inferior schools for the instruction of the subalterns of the forest-establishment.

153. BELGIUM.—Belgium had one forest-school, that of Bouillon, erected by royal decree in 1864, but recently suppressed.

154. PORTUGAL.—The Agricultural Institute at Lisbon embraces a course of study in sylviculture and forest-topography.

155. SPAIN.—This country had a forest-school at Villaviciosa, near Madrid, from 1846 to 1869; it was then transferred to S. Lorenzo d'Ecurial. The course extends to three years. It has a director, nine professors, and two assistants.

156. TURKEY.—Turkey has a forest-school at Constantinople, about which I could learn nothing.

* Gustave Henzé's report. † *Schweden Statische*, &c., 1873.

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SHEEP AND WOOL.

J. R. DODGE.

VIENNA INTERNATIONAL EXHIBITION, 1873.

REPORT

ON

SHEEP AND WOOL.

BY

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HONORARY COMMISSIONER OF THE UNITED STATES.

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REPORT ON SHEEP AND WOOL.

INTRODUCTION.

PROGRESS OF THE CENTURY IN SHEEP-RAISING; EFFECT OF CIRCUMSTANCES IN MODIFYING BREEDS; GROWTH OF DEMAND FOR WOOL AND OF SUPPLY.

1. The sheep, first among animals to be domesticated for the service of nomadic man, is of equal utility to the human race under the highest civilization; and the record of progress in that civilization in the past century marks an equal stride of improvement in the races of sheep. The flocks of a hundred years ago would be discarded to-day, even by the sheep-masters of the South American savannas or Australian hills, as practically worthless. They yielded a fleece smaller and of inferior quality, with less meat; were comparatively scrawny and ungainly in appearance, with long legs suited to a nimble search for food; and they required a longer period for growth and development. The change has been one in harmony with the practical aspects of recent general progress by which the fleece has acquired evenness, the fiber, adaptation to the popular want, the carcass, a larger proportion of profitable meat, with growth and maturity quickened to enable the nimble sixpence to surpass the slow shilling in the race for profit in meat-production.

Such is the record of sheep-husbandry in this country. It is the same in Europe and in other parts of the world where the enterprise of the European race has assumed the control of wool-production; and there is little furnished to the manufacturers of Europe and America that is not yielded to the care and capital of the European race. An examination of the wool-bearing animals of the temporary show at Vienna, and of the still more extensive collections of wool at the great exhibition, illustrates the same phases of improvement which have characterized wool-growing in this country.

2. Yet there are great differences in the minor details of this improvement that are suggestive and instructive, illustrating the necessity of adaptation to all surrounding circumstances. These differences not only constitute national peculiarities in sheep-breeding, but require the careful attention of the individual breeder who would make the most of his situation. In observing the methods of sheep-husbandry in different countries, and the quality and style of different breeds of sheep, the most obvious thought suggested is the governing force of circumstances, of climate, soil, status of agriculture, and local demand for meat or wool, in forming the prevailing style of sheep, whether of grade or

pure breed. The deduction is naturally made that the type of sheep found in any given locality is, therefore, the animal best suited to that region. Such a conclusion should be adopted very cautiously and with many limitations; otherwise progress would be impossible. The fact that modification, change for the better generally, is plainly seen in nearly every distinctive kind of sheep found in the civilized and progressive countries of the globe, to obtain meat of a better quality, or more in proportion to feed consumed, or wool either in larger quantity or better adapted to the changing requirements of manufacture, should be deemed conclusive of the necessity of keeping abreast of the changing conditions of sheep-husbandry. In a new country like ours, the sheep of which all owe their origin to flocks of foreign countries, it is necessary, not to look for guidance to the sheep accidentally brought into a particular section, but to the circumstances of soil and situation, of climate and culture, which affect production and profit. Yet we must not go to the other extreme and condemn as erroneous the practice of particular countries, differing from our own methods, which are usually in the main the best for those countries under existing circumstances.

3. With the progress in manufactures tending to variety and cheapness, the increase of steam-carriage facilities throughout the world, and the advance in the wages of the various industries, there has been a constant and rapid enlargement of the demand for wool. In this country the value of woolens manufactured has advanced from $4,413,068 in 1820 to $155,405,358 in 1870. In England, in addition to the home-grown product, the foreign wool-supply has increased from 8,609,368 pounds in the first year of this century to 342,986,862 pounds in 1874. Indeed, the factory-system may almost be deemed the growth of the past century. During this period, the clothing of the masses in civilized countries has ceased to be the province of home manufacture and the product of hand-looms, and has been left to organized effort, aggregated capital, and improved machinery. Seventy years ago, two-thirds of the British imports of wool were from Spain, and nearly all the remainder from Portugal; now two-thirds of the importation is from the Australian antipodes; but the Spanish supremacy of those days compares with the Australian superiority of the present as six millions of pounds with two hundred and twenty-five millions; and the total importation is nearly forty times that of the beginning of the century. The advance in the British consumption has been wonderful, yet the exports of wools, yarns, and other manufactures of wool have shown a great increase, amounting in declared valuation to £9,387,455 in 1816, and to £39,122,686 in 1872.

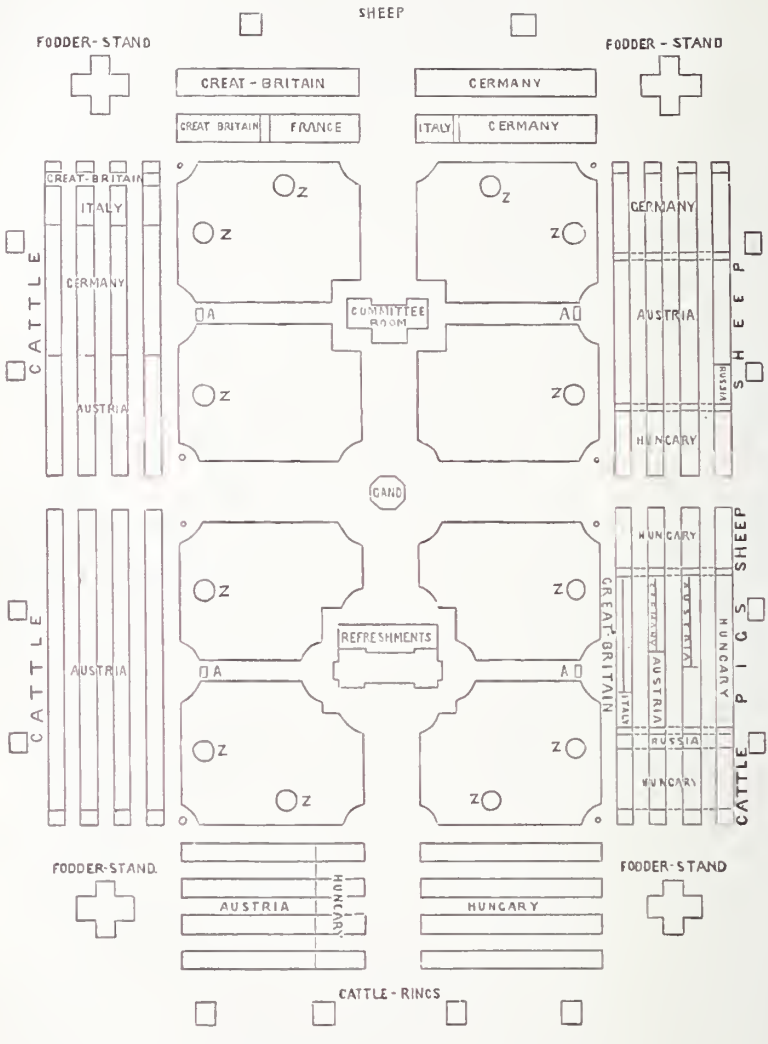

FIG. 1.—International Show-Yard.

A A Latrines. Z Z. Tents.

CHAPTER I.

THE INTERNATIONAL SHOW OF SHEEP.

EXTENT AND CHARACTER OF EXHIBITS; PLAN OF YARD; PREDOMINACE OF MERINOES; NUMBER OF ENTRIES FROM VARIOUS COUNTRIES; TENDENCY TO MUTTON-PRODUCTION; BRITISH ENTRIES; GERMAN ENTRIES; CHARACTERISTICS AND GRADE OF MERINOES; AUSTRIAN EXHIBITS OF MERINOES AND COTSWOLD-MERINOES; HUNGARIAN SHEEP; RUSSIAN SHEEP.

4. In connection with the International Exhibition at Vienna, a temporary show of domestic animals of all nations was projected, to continue from the 31st of May to the 9th of June inclusive. The countries nearest the place of exhibition naturally contributed most liberally, and Austria, on account both of proximity and direct interest in the success of the effort, made the largest contributions. Hungary, as a branch of the Austrian Empire, promptly assumed the second position. The Empire of Francis Joseph actually supplied nearly six-tenths of the sheep, five-sixths of the cattle, and above six-tenths of the swine, Hungary alone sending nearly half of the latter class. The number of sheep entered for exhibition was 1,504, contributed as follows: By Austria, 467; Hungary, 431; Germany, 377; England, 135; France, 69; Italy, 22; Russia, 3. Russia had only a single entry in each class, and America was unrepresented, as were Asia, Africa, and Australasia. This feature of the great international show was extremely interesting to the farmer and the naturalist, and especially to the woolen manufacturer.

5. The display afforded an opportunity of comparing European breeds, such as few of the visitors had ever before enjoyed. The arrangement of the animals was systematic in the plan, which is presented in the accompanying diagram, (Fig. 1,) but confused and unsatisfactory in its actual execution, making the work of the judges slow and difficult.

6. The merino families of sheep greatly predominated, as they do in all countries in which wool rather than mutton is the aim of the breeder. England, with a dense population to feed, and lands of high price, sent only long and middle wools. Germany contributed mainly Merinoes, thorough-bred and cross-bred, pure bloods and the ameliorated "land-sheep" of the country, with a fair proportion of the various breeds of English mutton-sheep. France sent only the Rambouillet Merino, which is the nearest approach to the meat-producing types of Great Britain yet attained by the wool-yielding race of Spain. Italy was represented only by the Bergamask sheep, an ungainly race, bearing a medium wool, and characterized by long legs, long and pendulous ears, and white face

and fleece. There were no living representatives of South America, Africa, or Australia, but the wool from those countries in the Exposition was nearly all of the merino type.

7. The predominance of Merinoes of the various families was very marked among continental exhibitors. Of the 377 animals from Germany, 291 were of this blood; 27 were Southdowns; 26 Oxfordshires; 8 Shropshires; and the remainder Suabian, Franken, and "Haidesnucke." A still larger number of Merinoes, though not averaging so high in purity of blood and other points of excellence, are found in the Austrian contribution—not less than 322 being entitled to this distinctive name from the predominance of Spanish blood. The Southdowns appeared to hold the next place in public estimation, having 68 Austrian representatives, with a strong strain of Down blood in no less than 25 placed in the merino class, and Cotswold-Downs, Southdown-Padnaner, and Southdown-Birki. The Zackel race and "Gadegast" sheep complete the list of 467 animals entered. Hungary presented 322 merinoes and grades in a list of 431, the black Siebenburger, the Wallachian, Zackel, Zigara, and other natives, constituting the remainder.

8. While this predominance of a single race is so evident, it is true that a tendency has been felt for years, growing stronger yearly, toward a larger infusion of English blood, and a greater comparative importance to meat-production; and the result of this exhibition, most of the English representatives being distributed for breeding-purposes, will be a manifest strengthening of this tendency. The improvement of Merinoes, so marked in the last twenty years, has been in the direction of larger yet more compact frames, enlarged flesh-taking capacity, and earlier maturity, with a coarser but heavier and more profitable fleece. Not less active than in the United States, for a generation past, has been the effort to mold the original flocks to suit the changed demands of the woolen manufacture and the pressing requirement for meat. The examination in detail of the material of the exhibition of the several countries will illustrate these aspects of sheep-breeding in Europe.

9. ENGLAND.—The Southdowns take the lead in point of numbers, with 40 animals; 20 from the flock of Lord Sondes, Elmham Hall, Norfolk; and as many from the Merton flock of Lord Walsingham. The former represented a flock of 1,200 pure-breed Sussex Downs, founded in 1823, and distinguished for symmetry and thriftiness. They were sold to go to Hungary, Galicia, North Germany, and Russia. The latter, from a flock of world-wide renown, were sold to the Archduke Albrecht for his estates in Austria; to Count Fries, Czernahora, Moravia; Baron Magnus, Dresha, Saxony; and to breeders in Russia. The Elmham Hall rams yield fleeces of 8 to 10 pounds, and those of Merton Farm are quite as heavy.

The Cotswolds numbered 26 in three entries. Those from the Agricul-

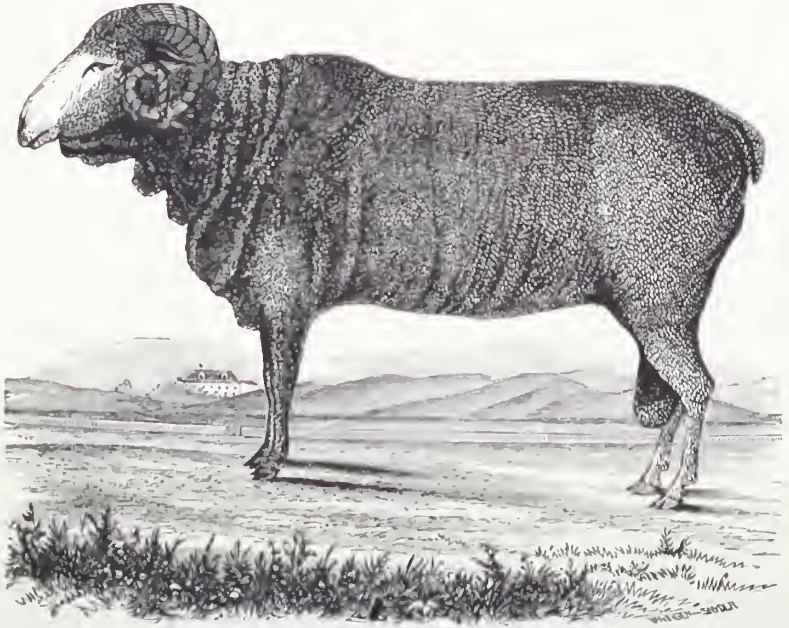

FIG. 2.—Thaer's Electoral-Escurial Ram, 1845.

tural College Farm, Cirencester, Gloucestershire, 12 in number, representing a flock of 200 ewes and 60 rams and 180 fattening sheep, illustrated well the especial aims of breeding at the college-farm, viz, a heavy fleece, depth of flesh, and great hardiness. The fleeces weigh from 13 to 20 pounds. The rams are in great request for cross-breeding with Southdowns, Hampshires, and mountain-sheep, to give length to the fiber and weight to the fleece. There were also eight from Mr. T. Beale Brown, Salperton Park, Gloucestershire; and six from Thomas Fulcher, Elmhall, Norfolk.

There were 13 fine Hampshire Downs from Messrs. Robert and John Russell, of Kent, producing fleeces averaging 9 pounds, and 16 long-wools yielding an average of 15 pounds. From Lord Chesham's flock of 350 Shropshires, in Bucks, came nine representatives, with 12-pound fleeces. Two fine Oxfordshire rams, bred by Mr. John Treadwell, Bucks, valued at £20 each, represented a flock of 700, of which the ram-fleeces usually weigh 18 pounds. There were some fine sheep from Lincolnshire, improved by crossing, for the production of long, lustrous combing wool, with fleeces weighing from 15 to 20 pounds.

The English section of the exhibition attracted much attention and ready purchasers. Seven of the Shropshires of Lord Chesham, 6 ewes and 1 ram, went to the estate of Baron de Rothschild, at Witcham, for £100. Two rams of the same flock were taken by the Duc de Coigny at £40 each. The Hampshire Downs and Kentish Long-wools, of the Messrs. Russell, were scattered through Prussia, Austria, Hungary, and Russia. The Lincolns, of the Messrs. Dudding, were all sold, some bringing £40 each, to Germany, Hungary, and Italy.

10. GERMANY.—The Merinoes of Germany have been greatly modified in later years by crossing, so that it might be impossible to find a flock with the precise characteristics of twenty years ago, though bearing the same name. The Electoral, Negretti, and Rambouillet are mingled according to the whim or judgment of the breeder, the better to suit his views of the demands of the market for wool or meat, and the result is the loss of the distinctive character of the originals. It might be impossible to find at the present day a counterpart of the Saxon ram of the Electoral-Escurial blood, an engraving of which (Fig. 2) is reproduced here from the United States Agricultural Report of 1847, as drawn from nature by Charles L. Fleischmann, esq. The spindle legs have been shortened, the flat ribs rounded, the bald head covered, and the very fine super-Electoral fleece has been displaced by longer, coarser, and more abundant wool, which brings more money at a slightly reduced price per pound. This was the prize-ram of Von Thaer's flock, one of the best and most highly improved in Germany. The wool was of excessive fineness, very short in staple, though not of full length when the drawing was made in August. The folds and wrinkles so fashionable since, were even then deemed desirable as indicative of a large proportion of fleece to live weight; indeed, we are told that the

Spanish shepherds were wont to kill the tight-skinned lambs of the best flocks, fearing their influence in producing light and thin fleeces. Nor would it be easy to find the Negretti type of those days.

11. The Merino of the present day, whatever its name, is a producer of a good quality of cloth-wool, is compactly and strongly built, with a head of good breadth and medium length, a short, full neck, a straight back, round barrel, and good breadth of shoulders and rump. The present flocks represent usually the grades of wool between the Prima and Electa, of the following scale of degrees of fineness, viz: (1) Prima, (2) Super-Prima, (3) Electa, (4) Super-Electa, (5) Super-Super-Electa. In Saxony seven degrees have been recognized, an additional "super" is employed, while "Secunda" comes in below Prima. The heads, belly, and feet of approved types are well covered, and evenness of fleece is deemed an important consideration. The wool is of medium length and fineness, nearly uniform upon all parts of the body, the fiber closely set, and the "closure" of stubble as nearly perfect as possible to protect the fleece from dirt.

12. A brief reference to the prominent breeding-flocks represented in the exhibition will indicate the status and tendency of wool breeding in Germany. Among the best Merinoes exhibited, though bearing fleeces remarkable for weight rather than fineness of fiber, were those of the flock of Herr Robert Gadegast of Thal Oschatz, Saxony, which includes 1,000 animals kept as breeding-stock, the males yielding fleeces of 8 to 10 pounds, the females clips of 4 to 5 pounds of close and even fiber, good felting property, with abundant yolk.

The old flock of Herr R. Holtz, Saatel, Barth, Prussia, which has been in course of improvement for more than half a century, and now numbers 1,500 large sheep, good feeders, yielding a long fiber suitable for carding, was well represented. Washed fleeces average about 7 pounds. This flock sprang from Kliphausen in Saxony, and in 1813 was transferred to Mecklenburg, and in 1817 to Pomerania.

Herr C. von Levetzow, Koppelow, Mecklenburg, from his flock of 800, founded by the Count of Halm-Remplin, contributed sheep of Spanish origin, with ewe fleeces of 6 to 9 pounds of fine wool.

Among the stock noted for fineness of wool, the flock of Herr Rudolf Meus, Jordansmuhl, Silesia, presented fleeces of exceptional fineness weighing about 3½ pounds. Herr Alfred von Rudzinski-Rudno, of Liptin, showed Electoral sheep of Prussian Silesia, from a noble flock of 1,000, bearing fleeces of superior fineness, with an average weight of 3 pounds.

Herr Ludwig Schröder, Buckholz, Brandenburg, Prussia, exhibited specimens of a carding-wool flock of full-bred Merinoes, originally obtained from France.

A Silesian flock of 200, founded sixty years ago upon the stock of Prince Lichnowsky, and afterward crossed with Negretti rams, was represented by the entry of Count Arthur Prinzenstein, Hoschutz. An

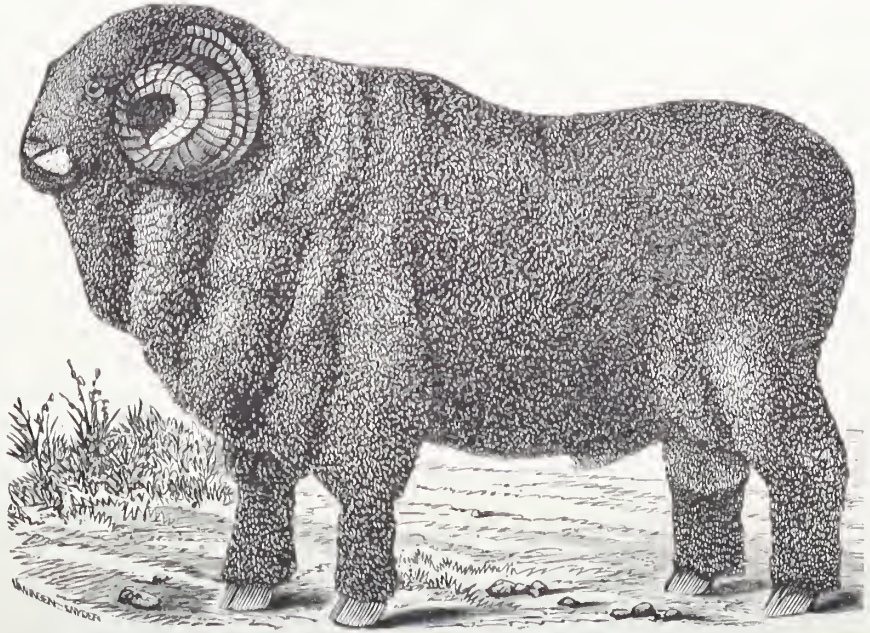

FIG. 3.—Kannenberg's Negretti Ram.

excellent quality of cloth-wool, weighing about 5 pounds per head, is the result of breeding on this estate.

A notable flock, at times including 1,100 pure-bred sheep, owned by Herr Adolf Heinrich Steiger, Lentewitz, Meissen, Saxony, was represented by eight fine animals. It has been bred for more than thirty years, without any admixture of blood, with reference to fineness, elasticity, and evenness of fiber. The original stock was imported from Spain by Prince Reuss in the beginning of the present century. The rams shear 12 to 14 pounds; the ewes 5 to 6 pounds.

An Electoral flock numbering 800, owned by Herr Wilhelm von Fontaine, Upper Silesia, was represented by animals of large size, bearing fleeces of fine cloth-wool weighing 8 pounds. Another large flock of Electorals, modified by Negretti blood, which has been in course of improvement for forty years with reference to perfection in evenness and fineness, was represented in the entry of Herr Freiherr von der Kettenburg, who keeps 1,600 in Schwetzin and 600 in Motgendorf. The clip of ewes averages from 4 to 5 pounds. The Electoral flock of 1,200 of Count Edward Oppersdorf, of more recent origin, yields fleeces weighing 5 pounds.

Specimens of a flock of 700 Electorals, springing from the Lehman breeding-fold, were exhibited by Herr G. von Wiedbach, of Culm, Prussia, bearing fleeces averaging 5 pounds.

Negretti flocks of considerable note were represented in the entries of Herr Robert Lehman, of Nitsche, Alt-Boyen, Posen; Count Kwilecki, of Oporowo; and Count Michynski, Posen. The Lehman flock of 500 ewes took high honors at the English and French expositions, and evidently has not lost prestige. Its fleeces average 5½ pounds. It was founded forty years ago with stock selected from the finest Negretti flocks of Mecklenburg, Silesia, and Moravia, and has since been fortified with the best attainable strains of pure Negretti blood. The Kwilecki fleeces are still heavier, averaging 6 pounds.

Among the breeders of Rambouillet-Negrettis, Herman Kannenberg, Gerbin, Prussia, is prominent. This flock exhibited great evenness and elasticity of fleece, with fiber 2½ inches in length upon ewes and 3 inches upon the rams. Figure 3 gives a good illustration of the style of this flock. The sire of this ram sheared 27 pounds of unwashed wool, which weighed 17 pounds after washing in hot water. The average weight of fleeces of the full-grown animals of this flock of 600 is 6½ pounds.

A fine flock of 600 Southdowns from the best English stock was represented in the entry of Baron Freiherr von Magnus, of Dresha, Saxony. Herr F. Neide, of Seschwitz, exhibited some specimens of a new breeding-fold of 400; and Herr George von Schoenermark, presented selections from his flock, derived from Lord Walsingham's celebrated Merton Southdown stock. Herr G. Stahlschmidt, of Canena, near Halle, Prussia, also exhibited representatives of a flock for fattening purposes, de-

rived from the English stock of Lord Walsingham, Sir W. Throckmorton, and Messrs. Jonas and Henry Webb. Weight of fleeces, 8 to 10 pounds.

A flock of Oxfordshire Downs was shown by Herr Ernst Botcher, of Gross-Lafferde, Hanover, with fleeces averaging from 7 to 8 pounds. This breed was also exhibited by Herr A. W. Brauer, Skludzewo, West Prussia, who presented specimens of an Oxfordshire-Merino cross, with white legs and faces, and bodies much larger than their fine-wool progenitors, and a fleece intermediate in its characteristics. Herr A. W. Schon, of Brestan, Prussia, entered specimens of his flock, originated with the design of furnishing full-bred Shropshires, for obtaining cross-breeds for fattening purposes. As might naturally be expected, flocks of comparatively recent origin, with unaccustomed management, feed, and climate, did not quite equal the appearance of the show-animals of Great Britain, which have represented the pride and glory of sheep-breeding of the fast-anchored isle. In this fact there is no proof of the necessity of deterioration in the removal of mutton-sheep to German pastures.

Among the native races were specimens of a small, active sheep, with horns and short tails, black faces, long wool of a brown color and heavy fiber, with a subcoat of fine down, exhibited by Herr H. Sprengel, of Schillerslage, Burgdorf, Hanover. They were catalogued as silver-gray heath-sheep, (Haideschnucke,) from Lüneberg-Common, on the northeastern section of Hanover, south of the Elbe, and are easily kept and quite useful in cropping the scant herbage of those wild areas which are now being gradually brought under subjection of the plow. They may be considered a German counterpart of the Black-faces of the hill districts of England and Scotland. Perhaps the most appropriately-named natives, or original sheep of the country, are those exhibited by Herr Philip Volcker, of Annweiler, Pfalz, Bavaria. They were characterized by a good degree of symmetry, a fleece of medium quality, white horns, white legs, and black faces.

13. AUSTRIA.—The Austrian section of the exhibition was first in point of numbers, and represented some of the largest flocks of Europe, mostly Merinoes. That of Herr Karl Ritter von Baratta, of Budischau, Moravia, numbers 3,000 head, bearing a fine, even, silky fleece, that of ewes weighing 2½ to 3 pounds. A fine flock of about 600 Silesian Merinoes owned by Count Franz von Bellegarde, and founded by Baron Turkheim, of Moravia, produces wool of Electoral grade, averaging 3 pounds per fleece. Herr Herzog von Cobürg-Gotha exhibited specimens of his flock of 1,800 in Walterskirchen, and one of 1,600 in Durnkrut, Lower Austria. The flock of 1,200 pure bloods of Prince Liechtenstein, Feldsburg, Lower Austria, is a very old one and very useful in furnishing rams for the improvement of flocks of that portion of the empire. Count Thun-Hohenstein, of Peruc, Bohemia, from his highly improved flock of 1,800, exhibited specimens bearing average fleeces of 4 pounds

of wool of super-electa and electa quality, such as obtained premiums at the London and Paris expositions. Baron Albert Freiherr von Klein, of Hennersdorf, Austrian Silesia, president of the Keltschan Sugar Company, showed his superior flock of Electorals, which has been bred pure since the first importation from Spain, 1770, up to 1865, at which date two rams from the Oschatz breeding-fold gave greater compactness and solidity to the body.

A fine flock of 800 combing-wool Merinoes was represented by the entry of Prince Schaumberg-Lippe, Ratiboritz, Bohemia. These fleeces are very heavy, averaging 14 pounds of wool, which loses 58 per cent. in washing, and the fiber is of unusual length in merino fleeces.

A very noted Moravian flock of 3,000, that of Josef Maria and Emma Aresin, of Partschendorf, and Erbredlnitz, Stauding, Moravia, was represented by 12 fine specimens of original Negrettis. The fleece must be deemed heavy, as the average of both sheep and lambs together is 3½ pounds after washing in warm water, of so fine a quality as to command an equivalent of a dollar per pound. They are in high favor among sheep-breeders of the Prussian states, Poland, Russia, Australia, and South America.

Several entries by Prince Schwarzenberg and his son, of Bohemia, represented two Negretti breeding-flocks of 1,000 each, in the domains of Frauenberg and Postelburg which are used to improve the sheep of their estates in Bohemia and Hungary, numbering 25,000 or more, scattered over a territory of half a million acres. The writer had the pleasure of seeing the home-flocks at Wittingau in Bohemia, during the progress of the exhibition. The object sought in breeding is a fine, strong, marketable wool, and it has been obtained so fully as to secure first-class awards at national and other exhibitions, and satisfactory prices in the market.

A flock of 2,500 Electoral-Negrettis, bearing a fine elastic wool of comparatively heavy weight, the fleeces of ewes weighing 4 to 5 pounds and those of rams 7 to 8, was exhibited by Count Wallis, of Kolleschowitz, Bohemia. Some of the best rams of this flock were offered at 600 florins, or $300, each. A very good Negretti flock owned by Count August Fries, Czernahora, Moravia, was represented by ewes offered for sale at 100 to 200 florins, and rams at 500 to 600 florins. Another Negretti flock of 3,500, bred for abundant wool of much fineness and elasticity, was exhibited by Count Heinrich Daun, of Skalitz, Moravia. An entry by Count Monnich-Larisch represented an Electoral-Negretti flock of 12,500, established half a century ago at Freystadt, Austrian Silesia. Several other flocks of considerable celebrity were represented at the show very similar in character to those above mentioned. The Negretti appears to be the favorite Merino family among Austrian wool-growers.

14. The Merino element is so prominent in Austria that the growing necessity for better mutton is beginning to be met rather by cross-breeds

than mutton-sheep of full blood. The Cotswold-Merinoes on exhibition commanded much attention. They are without horns, have the white faces of Cotswolds, and the pink noses of Merinoes. They are of good size, with a girth of nearly 6 feet over the wool. The fleeces at eleven months showed fiber 4½ inches long, much longer than the Rambouillet, finer than that of the Cotswold with much of its luster, and a fair degree of the curl of the Merino without its dirt and grease.

The union of Cotswold and Merino blood in the Keltschan Sugar Company's estate in Moravia has been more satisfactory in its results than any contemporary experience in cross-breeding. The change was effected by the use of imported Cotswold rams. The large area occupied, exceeding 6,000 acres, is hilly, and the pastures are covered with fruit-trees, suggesting sheep as the stock most appropriate to be kept. The old flock of fine wools was not profitable, the culls being almost worthless for mutton, upon which the rich beet-pulp was practically thrown away in an attempt to fatten them. The experiment was successful above expectation; the cross-breeds were thrifty, early attaining maturity, becoming fat at ten or twelve months old. After weaning, the lambs are fed with beet-pulp, hay, a little rape-seed cake, and oats, until a supply of mown clover is attainable, and later are pushed forward with mangolds. With such a course of feeding they weigh 140 pounds or more at twelve to fourteen months, and have brought at market an equivalent of 7 cents per pound live weight, or $10 per head. After the first cross it has been found best to breed in-and-in by selection from the same flock. A second flock was constituted with reference to very large size and great hardiness, by selecting large native ewes from the Carpathian Mountains, (Zackels,) and also Merinoes of unusual size and coupling with rams of any breed having requisite size and constitution. The offspring of these selected sheep were paired with Cotswold males from England, and their progeny in-bred without further crossing. The result is the Keltschan sheep exhibited by the sugar-company, a large animal, an average wether weighing fully 170 pounds at fourteen months and 225 at eighteen. This company also has a Southdown flock, and a cross-bred or a Southdown-Merino flock, the latter well adapted to medium lands, but surpassed by the Cotswold-Merinoes for rich lands, and by the heavy Keltschan sheep for profit as pulp-eaters and flesh-makers. The weight of fleeces of the Cotswold cross is fully 4 pounds, and of the others 3 pounds.

The Archduke Albrecht of Teschen, Austrian Silesia, exhibited samples of his pure Southdowns, and of his flock of 250 Southdown-Merinoes, and 650 Southdown-Birki half-breeds. The fleece is middle fine and salable.

An exhibition of improved Zackels made by Baron Jakob Ramaszkan, Galicia, justly attracted much attention. They produce fleeces weighing from 6 to 18 pounds of wool of better quality than the ordinary samples of this breed, and command a rental of $1.50 or more per head for their milk during the season.

15. HUNGARY. The Hungarian section comprised the largest number of animals, mostly Merinoes of Negretti or Electoral blood, though there was a single entry of pure Rambouillets. The English breeds were absent, except as amalgamated with the Transylvanian Zackel, of which cross there were representations from the flocks of Baron Banffy, of Klausenburg, and Count Emerich Miko, of the same locality, and also of those of Joseph Zeyk and Ladislaus Tisza. This cross, having the same base on one side as in the successful Keltschan amalgamation, proves to be a positive acquisition. The wool is greatly improved, being longer, finer, more lustrous, and the fleece is of far greater weight, and the flesh loses its strong flavor and is laid on with much greater rapidity. As milkers, a point for which the original Zackels are distinguished, they lose something by the Lincoln cross.

The Zackels are in many respects a valuable race. They are large, hardy enough to endure Hungarian winters without shelter, and yield an income annually of about $3 per head, derived in about equal proportions from wool, lambs, and milk, the latter producing about 15 pounds of cheese. There are black sheep and white in every flock, and in many flocks the black are preferred, the skin of their lambs being more valuable, though the wool of white sheep commands a higher price. The leg is short, and, for so large an animal, it is moderately fine-boned; and the wool is long and coarse, usually bringing an equivalent of 11 to 12 cents per pound.

Among other natives exhibited were Wallachian sheep of a migratory habit, living on the plains in winter and in the mountains in summer. They are large, of a reddish-brown color, hornless, and long-legged. Their owners go with them, and, accompanied by their families, live in the open air during the warm season and dwell in comfortable houses of wood as their winter-quarters.

The Merinoes exhibited were numerous, representing many and large flocks, one of them consisting of 25,000, and several were distinguished by wool of great fineness. They are bred for wool with very little regard to flesh. Evidently there is a tendency to change in this respect, in the direction of increase of weight and value of the fleece.

16. RUSSIA.—There was but a single entry of three Merinoes from Russia.

CHAPTER II.

RECENT IMPROVEMENTS AND PRESENT STATUS OF SHEEP-HUSBANDRY.

CAUSES OF DEVELOPMENT OF EUROPEAN BREEDS. GREAT BRITAIN: PROGRESS OF WOOL MANUFACTURES AND COMMERCE; OF SHEEP-CULTURE; CLASSIFICATION OF BRITISH BREEDS; LEICESTER SHEEP; BORDER-LEICESTERS; COTSWOLDS; LINCOLNS; ROMNEY-MARSH SHEEP; SOUTHDOWNS; SHROPSHIRE DOWNS; HAMPSHIRE AND OXFORD DOWNS; EXMOOR SHEEP; DORSETS; WELSH MOUNTAIN-SHEEP; CHEVIOTS; BLACK-FACED SHEEP; ROSCOMMON SHEEP. FRANCE: STATISTICS; DISTRIBUTION OF BREEDS; CROSS-BREEDING; RAMBOUILLET STOCK; BREEDING-ESTABLISHMENTS; FRENCH METHODS. AUSTRIA-HUNGARY: STATISTICS; METHODS. GERMANY: INTRODUCTION OF THE SPANISH RACE; STATISTICS; SAXON, PRUSSIAN, SILESIAN, AND BAVARIAN SHEEP-CULTURE. RUSSIA; STATISTICS AND BREEDS.

17. There are few of the races of sheep extant in Europe a century ago that have not felt the modifying effect of recent progress in manufactures. The extension and gradual perfection of woolen machinery made a demand at first for wool of finer quality, which was met by the dispersion and propagation of the Spanish fine-wool sheep, and by the amelioration of longer and coarser native wools through cross-breeding with the merino type. By such means fibers too fine and valuable for carpets and coarse cloths, and too long for card-wool machinery, became abundant, in quantity far exceeding that yielded by fine-wool sheep of pure blood. This stimulated invention in the direction of fancy worsteds and combing-wool fabrics of all kinds.

Again, increasing population in the most opulent districts demanded more and better meat-supplies; and breeding, with reference to enlargement and improvement of carcass and to rapid fattening by greater consumption of feeding-material, gave greater weight and length of fleece, requiring the aid of invention and effort to utilize such wools and popularize the fabrics made from them. In this way has arisen to public prominence a long line of coarse but strong and serviceable goods, which in their turn command the favor of fashion and often hold well their popular position. A portion of these mutton-breeds, and especially the lambs, possess a singular glossiness of fiber, a silkiness and tenacity that render them peculiarly suitable for lustrous fabrics of ladies' wear; and these have encouraged the extension of so-called lama and alpaca goods, and all sorts of gauzy and glossy stuffs so irresistible to feminine humanity in shopping excursions.

Such causes have operated and co-operated to produce the present styles of goods made of wool, and to shape the frame and covering of the animal that yields it. They account fully for the changes in the

modes of manufacture, the modification of the ovine breeds, and even the vagaries of fashion, in clothing-fabrics; for despotic as is the sway of fashion, it is itself full often the creature of inevitable necessity—the mother of invention, both of modes and machines.

Observation of the várious breeds exhibited at the international show of 1873 at Vienna, and inspection of European wools at the Exhibition, render more vivid the impression of universal modification and general improvement, for the best practical results, which the student of agriculture receives from the current record of progress in rural economy of the Old World. A brief reference to the prominent breeds of European sheep, with a glance at their history, will further illustrate the practical aspects of this subject, and may possibly prove the most utilitarian method of treatment of this report. First among the nations for radical and profitable results of improvement of sheep stands—

18. GREAT BRITAIN.—The first year of the present century found British manufactures of wool depending for their meager foreign supplies upon Spain and Portugal. Of the 8,609,368 pounds imported during that year, those countries sent, respectively, 6,062,824 and 1,731,934 pounds. Germany contributed 412,394 pounds, and the Netherlands 141,739 pounds. The remaining contributions were fragmentary and of small importance. The aggregate quantity imported annually has now reached 361,133,165 pounds—more than forty times the receipts of seventy-five years ago.

A glance at the manufactured goods reveals the remarkable change in modes of manufacture and style of fabric. In 1820 the value of exports of wools and manufactures of wool was £5,989,622. The largest item was cloths, £2,477,643, with smaller amounts for coatings and Kerseymeres; while there were of woolen and worsted stuffs, £1,782,835; £282,860 for flannels; £185,956 for blankets, and £117,073 for carpets. These were not only the days of small things, but the worsteds, all sorts of combing-wool fabrics, and carpets, were items particularly small. Fifty-two years later these exports reached the sum of £32,383,273, of which worsted stuffs were valued at £20,905,163, and cloths, formerly constituting the bulk of the exportation, only £3,991,718. These facts, together with the ever present necessity of enlarged meat-supplies, furnish the key to the changes which have taken place in British sheep-husbandry.

19. This change is briefly indicated. As the short-horn type has as a model given direction even to the improvement of other breeds of British cattle, so has the ruling idea in that improvement dominated in the modification of the original breeds of sheep, as illustated in the creation of the present Leicester type, and in a less degree in the changes in all the other breeds. More meat, of a better quality, in a shorter time, has been the maxim of British sheep-breeders.

The official returns of Great Britain show that the farm-areas there carry an unparalleled amount of live stock. The latest figures for

England, for 1874, represent an area of 32,597,398 acres, of which only 24,008,368 are in crops of all sorts, grass, and bare fallow, carrying 19,859,758 sheep, besides 4,305,540 cattle, 1,007,398 horses, and other live stock.

Lincoln County, with 1,629,011 sheep, has 237,621 acres in green crops, 164,047 in grasses and clover in rotation, and 416,869 in permanent pasture. Here is about the same area in roots and hay as in pasture, and twice as many sheep as total acres, with 212,800 cattle and some other stock.

The returns from Scotland covered 19,496,132 acres, of which only 4,579,821 are utilized in grass and other crops, and yet the sheep number 7,389,487. In one county, Argyle, there are 1,061,873, and only 87,568 acres in pasture and forage, divided into 12,095 acres of green crops, 18,946 of grasses in rotation, and only 56,527 in permanent pasture. Were mountain-lands included, there are more than half as many sheep as acres returned.

20. The British breeds are most naturally divided according to altitudes and fertility of their habitat. The large breeds, white, hornless, and bearing long wool with small felting property, occupy the rich alluvial districts, the lands reclaimed from the sea, and the highly cultivated and very productive farm-areas. These are the Leicester, Lincoln, Romney Marsh, Cotswold, the few remaining of the Devonshire Notts, the Roscommon, and similar Irish sheep. Next should be classed the sheep of the chalk-downs, the commons, and forests, suited to a dry and temperate climate. There are the Downs of several families, perhaps now to be taken as breeds, the Dorsets and their congeners, the pink-nosed Somersets. They produce a short felting-wool, suited to inferior grades of goods. The Ryeland, formerly found in the western counties, and esteemed for producing the finest cloth-wool of England, is now almost extinct. The third general division comprises the mountain-breeds, first the Cheviots of the hills of the North of England and borders of Scotland; the Black-face of the central chain of mountains and moors northward from Derbyshire to the mountains of Scotland; and two varieties of Welsh mountain-sheep, and the Kerry and other mountain-breeds of Ireland. There are many local remnants of the ancient stock allied to the above, but there are none worthy of special mention.

The weight of fleece of British sheep averages about 5 pounds. The Lincolns may be placed at 8 pounds, the Cotswolds nearly the same, the Leicesters at 7, the Downs at 4, the Cheviots at 3, the Black-faces at 2½, and the Welsh at 2. The Leicesters are most numerous, exceeding one-third of all; the Downs one-sixth, the Black-faces nearly as many, Cheviots one eighth, leaving about one-fifth for other breeds. The heavy breeds of eighty years ago, modified mainly by the Leicester, now furnish lighter fleeces. For instance, the Lincoln, as reported by Hon. Robt. R. Livingston, then yielded 11 pounds; the Teeswater and Cotswold, 9 pounds. These are, of course, average weights, as rams as

well as pampered ewes and wethers, greatly exceed the average. The weight of carcass exceeds by 20 per cent. the weight of imported mutton, and averages 60 pounds; by some estimates, 65 pounds. A brief reference to this improvement, with the characteristic points and present status of the principal breeds, will indicate more fully the progress of the century in sheep-husbandry.

21. *Leicesters.*—The Leicestershire sheep, in the beginning of the Bakewell era of improvement, were known by their names, the old Leicesters, the new Leicesters, or Dishleys, (the latter from Bakewell's place of residence,) and the forest-sheep. The Dishley experiment commenced in 1755, and was continued so successfully that the rams of their famous flock ultimately commanded $15,000 as hire for the season, giving an impetus to the improvement which was perpetuated by the permanence and desirability of the results achieved, until the breed assumed a position which has been maintained to the present time.

The original Leicester upon which Bakewell commenced his experiment was an animal of large frame, with heavy bone and coarse-grained meat, a flat-sided carcass, and legs large and rough. It was a slow feeder and necessarily late in reaching maturity, weighing at two or three years old 100 to 120 pounds. Seeing the necessity of obtaining, in addition to the fleece, the largest possible increase of flesh in proportion to the food consumed, in the shortest period of time, he bred by selection most persistently and skillfully for these objects. With these aims always in view, he chose with rare judgment, yet with a broad latitude as to breed or family, such animals as would approximate his ideal of compactness and symmetry, refinement of bone, a reduction of the proportion of unprofitable parts, and higher capacity for rapid conversion of food to flesh. After securing this result by animals of characteristics so widely differing from those of the original stock, he found necessary a rigid adhesion to the practice of in-and-in breeding to keep the advantage gained, until a fixedness of type had been secured which should impress itself surely and indelibly upon any race which might be selected for improvement.

In accomplishing results of such practical value, with all possible care to retain the sound constitution and great hardiness of the old stock, there was perhaps inevitably induced a comparative delicacy, a reduction in size, a decrease in prolificacy, and excellence as nurses. These defects have demanded the wisest judgment in the infusion of fresh strains of blood, by which the stamina of the race has been fortified, and its popularity maintained at a high ebb until the present day, to such a degree that the Leicester blood is far more widely diffused than that of any other breed, even modifying essentially all the long-wool races, and to some extent the mountain-breeds, and some families of the short-wool Downs.

22. The true type of this breed, as understood by Youatt, is thus described: "The head should be hornless, long, small, tapering toward

the muzzle, and projecting horizontally forward. The eyes prominent, but with a quiet expression. The ears thin, rather long, and directed backward. The neck full and broad at its base, where it proceeds from the chest, so that there is, with the slightest possible elevation, one continued horizontal line from the rump to the poll. The breast broad and round, and no uneven or angular formation where the shoulders join either neck or the back; particularly no rising of the withers or hollow behind the situation of these bones. The arm fleshy through its whole extent, and even down to the knee. The bones of the leg small, standing wide apart; no looseness of skin about them, and comparatively bare of wool. The chest and barrel at once deep and round, the ribs forming a considerable arch from the spine, so as in some cases, and especially when the animal is in good condition, to make the apparent width of the chest even greater than the depth. The barrel ribbed well home; no irregularity of line on the back or belly, but on the sides; the carcass very gradually diminishing in width toward the rump. The quarters long and full, and, as with the fore legs, the muscles extending down to the hock; the thighs also wide and full. The legs of a moderate length; the pelt also moderately thin, but soft and elastic, and covered with a good quantity of white wool."

The Leicester requires less food in proportion to weight than any other race. They are mostly sold early, in the summer or early autumn after their first year, many wethers at twelve to fifteen months weighing 20 to 25 pounds per quarter; and at two years they attain the weight of 30 to 37 pounds. The fleeces are valuable as fine combing-wool, and, if well grown, weigh from 7 to 8 pounds each.

23. The earliest record of these sheep in the United States is a mention by Custis of the Bakewell ewes on the estate of Washington, from which, through a cross by a Persian ram, was derived the somewhat famous Arlington long wooled sheep. The influence of this and other long-wool flocks of Virginia gave a popularity to the English races which has continued to the present day, though the preference at present appears to be given to the Merinoes, especially since the war and its accompanying destitution and lack of thrift. Kentucky also gives a preference to the Leicester, as a fit companion to the short-horn bullock upon the blue-grass pastures. They are to be found in small numbers in the Middle and Ohio Valley States, generally in a semi-degenerate state, not bred up to the modern standard of the perfect Leicester in his English home. Mr. Samuel Campbell, of New York Mills, N. Y., has imported several first-class specimens, and a few years since had a two-year-old that weighed 300 pounds.

The mutton of Leicesters is too fat to suit American taste, yet that of grades is quite palatable, though coarse grained, with too much outside fat. Even in England meat of animals two years old is less valuable than that of lambs or shearlings; and the price is always materially lower than mutton of Southdowns and the mountain races.

FIG. 4.—Wallington, a Border Leicester Ram.
(Owned by Lord Polworth, Mertoun, Berwickshire.)

24., *Border-Leicesters.*—More than a century ago some of the sheep-folds of the border were reinforced by Leicestershire sheep of established repute. Early in the present century representatives of the Dishley stud began a contribution to the improvement, which has been continued until they have won a distinct position in the show-yard and in popular esteem. The characteristics of this breed, as given by Mr. John Wilson, are extraordinary aptitude to fatten and early maturity. He says: "The most marked feature in their structure is the smallness of their heads and of their bones generally, as contrasted with their weight of carcass. They are clean in the jaws, with a full eye, thin ears, and placid countenance. Their backs are straight, broad, and flat; the ribs arched, the belly carried very light, so that they present nearly as straight a line below as above; the chest is wide, the skin very mellow, and covered with a beautiful fleece of long, soft wool, which weighs, on the average, from 6 to 7 pounds. On good soils, and under careful treatment, these sheep are currently brought to weigh from 18 to 20 pounds a quarter at fourteen months old, at which age they are now generally slaughtered. At this age their flesh is tender and juicy, but when carried on until they are older and heavier, fat accumulates so unduly in proportion to the lean meat as to detract from its palatableness and market-value."

25. The ram represented in the accompanying engraving (Fig. 4,) (which is produced from a photograph received from the Agricultural Gazette, of London)* is from the Mertoun flock of Lord Polworth, in Berwickshire. This flock contains unsurpassed specimens of this breed. Two ewes once exhibited at the Highland show measured 4 feet 9 inches in girth; and a shearling (which means yearling) ram at the same show measured 5 feet 1 inch, and 45 inches in length from the back of the head to the tail. This flock was established by Mr. Scott, grandfather of Lord Polworth, and has been steadily progressing in excellence. The engraving does not indicate a pampered sheep, intended only for the show-yard, but the straight and broad back, the wide chest brought well forward, the well-sprung ribs and long quarters, the full and square rump, all bespeak an animal compact and symmetrical—a meat-maker of the highest order.

26. *Cotswolds.*—This is one of the largest English breeds, though the improved race is smaller than the originals, on account of the influence of the Leicester element in its amelioration. As a breed it is of great antiquity. It has gained in fleece and form, and comes to maturity earlier; is more prolific than the Leicester, and has greater strength of constitution; is often fattened at fourteen months, yielding 15 to 20 pounds per quarter, and 20 to 30 if kept till two years old. The fleece is 6 to 8 inches in length, and sometimes much longer; is strong, somewhat coarse, of good color, and yields a heavy fleece. The mutton is

* To the same source should be credited photographs of the other engravings of English sheep.

superior to that of the Leicester, with a smaller proportion of fat, and the sheep are also superior to that popular breed in weight of wool, size, hardiness, and vitality. They are possessed of good figure, have a large head, well set on, a broad chest, a well-rounded barrel, and a straight back. They are often used for crossing upon other breeds, and for obtaining earlier market-lambs both in this country and in Europe. They are more widely disseminated in this country than any other long-wool, and preserve well the popularity which they have attained here. Some imported sheep of this breed have borne fleeces in this country of 18 pounds.

27. *Lincolns.*—The old Lincolns, of the fertile meadows of lower Lincolnshire, were remarkable beyond any contemporary breed for coarse and heavy forms and length of wool, the fleeces weighing 10 to 12 pounds. They were hornless, with large limbs, hollow flanks, and flat sides. They shared with the Romney-Marsh sheep the alluvial and fen districts, consumed largely their rank pasturage, and fattened slowly. When the fame of Bakewell at Dishley was rising to its zenith, recourse was had to his improved Leicesters for improvement in the flesh-taking property, and this course of crossing was pursued to the close of the eighteenth century, and indeed to the present time, for the purpose of securing a better form and earlier maturity without losing wholly their peculiarities of size and length of fiber.

For at least a quarter of a century a sharp contest was waged between the supporters of the old and the new, the former fearing the loss of hardiness and local adaptation, as well as its unrivaled peculiarities of fleece, while the latter were quite willing to risk any or all of these results in the belief that more mutton and wool and money could be realized upon each acre of area than with the modified Lincolns. And the latter ultimately prevailed, and verified the correctness of their theory.

The effect of this change upon the wool has been to make it shorter and finer, and to diminish somewhat its softness of fiber. It is a question if the peculiar quality of the wool could not have been retained in larger degree without essential injury to its meat-producing quality. This district still produces the largest sheep of Great Britain, with fleeces superior in weight and value to any other. They are not equal in earliness of maturity to the Leicesters, but they are profitable, and suitable to the rich lands they occupy, wethers frequently attaining the enormous weight of 50 to 60 pounds per quarter.

28. *Romney-Marsh.*—There is another breed of English sheep inhabiting the rich, alluvial soil of Kent known as the Romney-Marsh sheep, which pertinaciously retains its distinctive features, though modified and improved by recent breeding. It is a large sheep, not very symmetrical in form, having narrow fore quarters and flat sides, and coarse bone and muscle. It has a white face, a long and thick head, and a tuft of wool on the forehead. The wool is of more value than the mutton, perhaps, (but would not be profitable without it,) being long, fine, and lustrous, and in demand at good prices for export to Flanders and to France, for

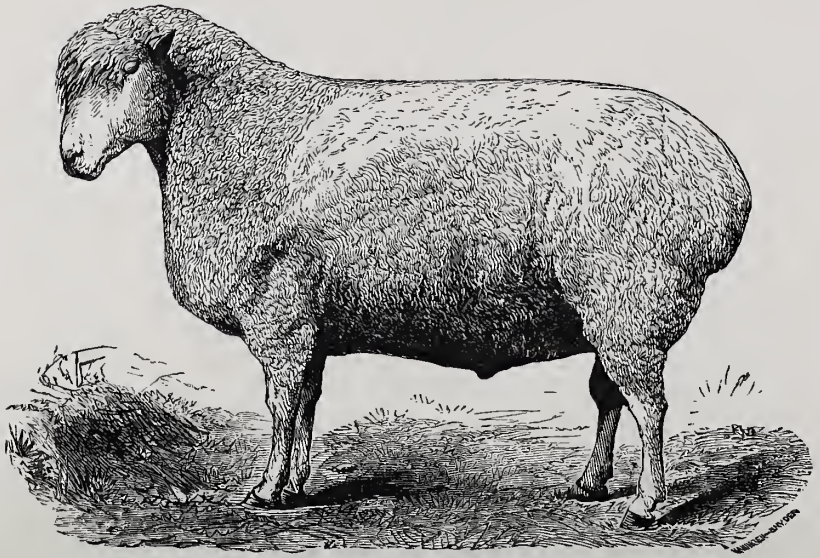

FIG. 5.—Prize Cotswold Ram.

(Flock of Cirencester Agricultural College, England.)

FIG, 6.—Southdown Ram.
(Owned by Lord Walsingham.)

the manufacture of "cloth of gold" and similar fabrics. Other breeds have been introduced upon the marshes, but cannot maintain themselves in competition with the Romneys. The country is flat, open to the east, and very bleak, yet these sheep live through the winter in the open fields, and have little protection or supplied food. The ewes are comparatively prolific, about 30 per cent. of doubles being expected in reproduction. The lambs come late after the severity of the winter is over. With a good course of turnip-feeding after the first wintering they can be brought to 17 pounds, sometimes to 18 pounds, per quarter, yet they are more frequently kept over a second winter. They are not very early in maturing, and grass is the main reliance for growth if not for fattening. There are cattle on the farms, but sheep greatly predominate and furnish the principal profits.

The pasture-lands of the marsh differ greatly in productiveness. There are "feeding-lands," keeping two or three ewes in winter and twice as many in summer; and the "fattening-lands" keep four or five sheep per acre. The hardiness of this breed and its adaptation to the locality is indicated in the following from the London Field:

"We remember passing through a portion of the marsh during winter, and being struck with two things, the exceeding greenness of the grass, and the number of big, robust-looking ewes, which rather crowded than dotted the plain. A keen east wind penetrated our bones, despite our Ulster, yet the sheep minded it not a bit; and we learned, to our great surprise, that, save in deep snow or prolonged frost, they fended for themselves, and then only got a mouthful of hay. No wonder that they held their own; they were on their native ground, and not to be disturbed. There are still large graziers who object to using hay, even when the ground is covered with snow, preferring the sheep to scratch down to the grass. In former times it was but too common for the ewes to be left entirely unprotected during the lambing-season, and great were the losses in times of severe frost. Now the ewes are placed in a sheltered inclosure near the homestead, or a temporary ewe-pen is erected wherein the ewes lie at nights, supplied with hay and a few turnips, if they can be spared, and where the lamb is sheltered for the first few days of its existence, care being taken not to render it delicate by too much protection."

29. *Southdowns.*—The original Sussex or Southdowns, have probably the purest blood, free from admixture during the long period which covers the rise and development of the British wool-manufacture and the increase of meat-production, of any race of British sheep. Their improvement has been long-continued and is still continuing, apparently without the necessity of recurrence to any foreign blood for amelioration of a single objectionable point. While they have been greatly improved, progress has invariably been in the direction indicated in the distant past, and not by radical and violent changes. It has been carried on, there is little reason to doubt, solely by selection, there being little, if any, positive evidence that the Leicester or other blood has

aided in the amelioration. In the production of Hampshire and Shropshire and other breeds bearing the Down name, it is well known that other blood has been effectively used; but it should be remembered that these families, or rather breeds, are not really improved Downs, but have come from selected individuals of other hardy primitive breeds, molded into a modification of the Southdown type by large and repeated infusion of that blood, with occasional dashes of Leicester to give greater size and aptitude for fattening. The changes effected in the true South (or Sussex) Downs have been mainly these: Speckled faces have been changed to a uniform tint of brown or fawn color, sometimes almost a gray; the forehead and cheeks have been partially covered with wool; a greater symmetry of form has been obtained; a larger size and greater fattening aptitude. The flock of Lord Walsingham exhibits some deviation from the Sussex type, having somewhat greater length and a decided development of the fore-quarter, giving greater weight at the expense of somewhat reduced value to the butcher. They are splendid animals, and have been largely sought by continental purchasers, though disapproved by many breeders of pure Southdowns.

By reason of its purity the Southdown, perhaps, has stamped its peculiarities upon its cross-bred offspring more certainly and strongly than any other of the English breeds; and for this reason, together with its hardiness and the unsurpassed quality of its mutton, it is deemed of greater practical value in its crosses than in its pure bred flocks. But for the fact that quantity and quickness in lamb-production are of more pecuniary value than superior quality, it would far surpass the Leicester in its prevalent use for cross-bred early lambs.

30. It is now about one hundred years since Mr. Ellman, of Glynde, Sussex, sought a more symmetrical and profitable form, and a superior flesh-and-fat-producing habit, without injury to constitution or fecundity; and he pursued his object slowly, cautiously, with a judgment, patience, zeal, and intelligent liberality that insured success. The light fore quarters, narrow chests, and long necks and limbs, were totally changed. This is the description given by Mr. Ellman, himself, to his improved sheep:

"The head small and hornless; the face speckled or gray, and neither too long nor too short; the lips thin, and the space between the nose and the eyes narrow; the under jaw, or chap, fine and thin; the ears tolerably wide and well covered with wool, and the forehead also, and the whole space between the ears well protected by it as a defense against the fly; the eye full and bright, but not prominent; the neck of medium length, thin toward the head, but enlarging toward the shoulders, where it should be broad and high, and straight in its whole course above and below. The breast should be wide, deep, and projecting forward between the fore legs, indicating a good constitution, and a disposition to thrive. Corresponding with this the shoulders

should be on a level with the back, and not too wide above; they should bow outward from the top to the breast, indicating a springing rib beneath and leaving room for it, the ribs coming out horizontally from the spine, and extending far backward, and the last rib projecting more than the others; the back flat from the shoulders to the setting on of the tail; the loin broad and flat; the rump long and broad, and the tail set on high, and nearly on a level with the spine; the hips wide, and the space between them and the last rib on either side as narrow as possible, and the ribs, generally speaking, presenting a circular form like a barrel; the belly as straight as the back; the legs neither too long nor too short; the fore legs straight from the breast to the foot, not bending inward at the knee, and standing far apart both before and behind; the hocks having a direction rather outward, and the twist, or the meeting of the thighs behind, being particularly full; the bones fine, yet having no appearance of weakness, and of a speckled or dark color. The belly well defended with wool and the wool coming down before and behind to the knee and to the hock, the wool short, close, curled, and fine, and free from spiry projecting fibers."

31. *Shropshires.*—Another branch of the Down family, in which amalgamation has brought valuable compensations for departure from the true Sussex type, is the Shropshire sheep. It is founded on the ancient Longmynds of Shropshire, and the occupants of Cannock Chase, in Straffordshire, heath-sheep, which were noticeable for unusual size and thrift, thus described by Plymley in 1803: "There is a breed of sheep on the Longmynd with horns and black faces that seem an indigenous sort; they are nimble, hardy, and weigh near 10 pounds per quarter when fatted. The fleeces upon the average may yield 2½ pounds, of which one-half pound will be the breechens, or coarse wool, and is sold distinct from the rest. The farmers of the hill-country seem to think the greatest advantage they derive from the access of foreign stock is from the cross of the Southdown with the Longmynd sheep; the produce they state to be as hardy and to bite as close as the Longmynd sheep, and the weight of the carcass is increased." These sheep were small of frame and light of fleece, compared with the Southdown. About this time the Southdown cross became quite popular. The same course of improvement has continued, directed toward an increase of size and development of feeding capacity. While it has proved successful, it has not been under the predominant control of one directing mind, and a slight want of unity in the work of the principal breeders has been manifest, tending to wider divergence under unskillful breeders. Some of the principal improvers, after employing the Southdown to straighten the spine of the coarse originals, and give them oblique shoulders and well-sprung ribs, found it necessary to infuse a Leicester strain to shorten the back and chine and give fattening aptitude; after which a course of close breeding was necessary to fix these characteristics. Others sought more slowly, and with comparatively doubtful result, to obtain similar or equally desirable qualities by selection alone.

The resultant lack of uniformity for a long time kept the Shropshires from being recognized as a distinct breed; yet the enterprise and intelligence which continued the improvement, by judicious selection from the best flock, succeeded in winning the recognition of the Royal Agricultural Society in 1850, since which date the entries at the great shows have been numerous, and the animals shown increasingly popular. Lord Chesham, who exhibited at Vienna, is one of the most successful of the present breeders of Shropshires.

This breed is now of larger size than the Southdown, with longer face of uniform dark tint, a full and spirited eye, spreading ears of good size, and a forehead rather flat and well wooled. They are very prolific, the ewes generally bringing doubles if well cared for, and what is better still, the mothers are amply able to bring up the lambs in good condition. They excel the Southdown in yield both of mutton and wool. They scarcely attain the weight of the Hampshires, but reach maturity earlier, and have less bone and offal. Their fleece-weight is generally from 5 to 7 pounds. The meat is like the Southdowns in fineness of texture, the presence of fat in the tissues, and richness of color. At twelve or fifteen months they will sometimes reach 20 pounds per quarter. They bear close folding well, are found hardy in moist climates, and will endure a wide range of soils and feeding.

32. *Hampshires.*—This family of Downs, unlike the Sussex, is founded through skillful breeding. It was effected in harmony with the idea of more meat in a shorter period of time—the same which originated the Leicester and the Shorthorn—by admirers of the Southdown style, who saw in the size and the early maturity of the Wiltshire horned sheep and the Berkshire Nott, qualities forming an admirable foundation for a breed upon which the fine form and superior quality of flesh of the Down could be ingrafted. It is worthy of notice that a breed which has long displaced the original Sussex Down and other breeds in Berkshire, Hants, Wilts, and Dorset, has been made what it is, in the hands of skillful breeders, by the blood of the finest specimens of the race which they now dominate in all this section. This change is a natural result of the inclosure of the commons, the introduction of artificial manures, and the production of such crops as turnips, rape, vetches, trifolium, rye, and Italian rye-grass. This is one of the facts with which the history of British sheep husbandry teems, illustrating the necessity of change in breeds, with changed conditions of production or consumption. It is estimated that the weight, both of mutton and wool, has been increased in this region 50 per cent.

The statistics of 10,000 Hampshires for three successive years showed the average yield of lambs to be 91 per cent., the mortality of ewes 5½ per cent., and of tegs 3 per cent. per annum. The wool is of fine quality, but short staple, averaging 4½ pounds per fleece. The best specimens of these sheep may be found at the Overton and Weyhill fairs, in Hampshire, and the Britford and Wilton fairs, in Wiltshire. At the

FIG 7.—Hampshire Down Ram.
(Imported by Robert Morrell, Long Island, N. Y.)

latter, February lambs realize 55*s.* to 72*s.* per head; the finest thus commanding an equivalent of about $18 in gold for butchering. The wether-lambs are now usually sold in the latter part of summer or early autumn, and the ewes are kept three years for breeding. The period of service of rams is from August 1 to the middle of September.

The ewes are usually kept on turnips and hay during the winter, the hay being cut into chaff with a portion of straw, and sometimes seasoned with a little malt-dust, bran or cake. The lambs go out on turnips, if the weather is fine, in a few days after they are dropped, though many farmers keep them penned for two or three weeks. After April 1 they leave their diet of turnips and hay, and go to the water-meadows by day, and are folded at night on Italian rye-grass, winter-barley, or trifolium, the wether-lambs getting a little cake or corn. On farms that have no water-meadows a larger supply of late swedes is secured, and the lambs are kept upon winter-growing grasses and forage-plants until the vetches are in bloom. Early in May they are weaned, when it is common to pasture in clover by day and fold on vetches by night. When the vetches are consumed, the sale lambs are supplied rape and cabbages and the ewe-lambs follow to consume what the wethers leave. Thus managed, the lambs attain great size and command high prices. Formerly they were largely sold, from July to September, to go to Kent and Surrey, and other points near London, to be fattened for the markets of that city. They are now so good that they are sold for immediate consumption. It is deemed proper to give somewhat in detail the mode of management in fat-lamb growing, not only to show the practice employed with this particular breed, but to call renewed attention to the necessity of high feeding in this business, and illustrate again the constant variation in feeding and management to meet the requirements of changed or differing circumstances.

33. *Oxford Downs.*—This breed is produced by a successful course of cross-breeding of Cotswolds with Hampshire ewes, a dash of Southdown blood being used occasionally to perfect the cross. It is an animal characterized by great hardiness of constitution, good size, heavy fleece, facility of fattening, and excellent mutton. It yields a desirable quality of thick and heavy wool, weighing about 7 pounds per fleece. Mr. Spooner has called it the most successful attempt at cross-breeding ever made in England. It has been claimed by some to be the best rent-paying breed in the country.

34. *Exmoor Sheep.*—In the mountainous section of Somerset are found the Exmoor sheep, a horned breed, so hardy that a few days' burial in a snow-drift is said to be not too severe a test of their endurance. They have long been remarked for their drum-like roundness of form, though they are becoming square under the recent efforts of breeders. They are larger and in all respects better than the Welsh mountain-sheep, good feeding bringing them up to 18 and 20 pounds per quarter, and in some cases to 24 pounds. At 18 months they can be made to weigh 15 to 20

pounds per quarter. The Welsh, the Scotch black-face, the Cheviot have been tried upon the Somerset hills, but most farmers have gone back to the improved Exmoor. They have white faces, legs, and fleeces; the wool close set and now increased in weight from 3 pounds up to 4 pounds. Their mutton is of excellent quality. The lambs come in March and April, and are weaned at midsummer. After being turned upon the hills they are brought in at shearing and weaning time, when the lambs are separated and kept for some weeks in inclosures for the purpose. The drafted ewes are often purchased for lamb-breeding, as they are prolific mothers and good nurses.

These sheep, though the denizens of mountains, have habits quite unlike the Welsh, and are at home in the fertile valleys which intersect the range of 1,000 to 1,500 feet elevation. Hillside cultivation and catch-water meadows are concomitants of their habitat. Where the commons can be inclosed, and the rotations and crops of the low countries adopted, it is found in the event of such changed conditions that a Leicester cross affords the best profit; otherwise, the pure Exmoor gives the best satisfaction. In such facts we see the reason for, and indeed the necessity of, the very breeds of sheep so common in a given district, which may be all unlike a popular and paying race in an adjoining section.

35. *The Dorsets.*—A very ancient race of sheep is found in the county of Dorset, which formerly included a large tract of country. It has some resemblance to the Merino in form, but none in other respects. In 1749 they were described by Ellis as having "white fleeces, white and short legs, broad loins, and fine-curled wool." They still have white legs and faces, and show some increase in length of limb and in weight of fleece, which averages about four pounds of fine wool without sufficient softness for goods of first quality. Its great distinguishing peculiarities, which prevent its extinction as a breed, are its early breeding and fecundity, rendering it popular for early lambs, dropped in October, and fit for table at Christmas. There is a paying demand for them raised as house-lambs for the London market. Either Leicester or Southdown rams, preferably the latter, are generally employed, making the lambs a Dorset cross. Some have attributed their peculiarities to an origin in a warm climate; others to the comparative mildness of climate, a calcareous soil, and to the abundance of thyme and aromatic plants in the herbage.

These sheep are hardy, fold well, subsist on scanty pasturage, and wethers at three years old furnish mutton weighing 18 pounds per quarter. While their range has been reduced by the predominance of the modern Leicesters and Southdowns, they maintain a better footing in the county of Somerset than in Dorset itself, exhibiting here slight difference in type, especially showing a pink-colored nose like the Merino, and often called the pink-nosed Somerset. They have also somewhat greater length of wool, larger lambs, and mutton heavier per quarter.

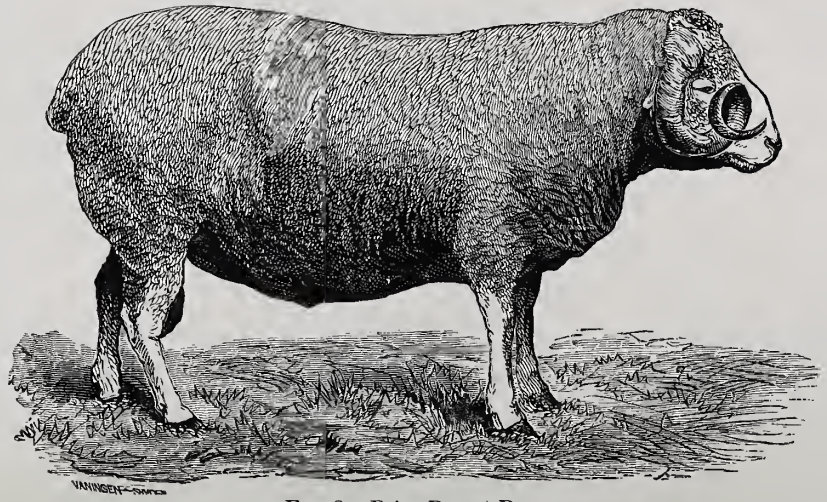

FIG. 8.—Prize Dorset Ram.
(Owned by Mr. James Culverwell, Somersetshire.)

Other varieties of the Dorset group, inhabiting the older commons of the south and west of England are nearly extinct, though traces of them may still be found. One variety, inhabiting the isle of Portland, still exists in a state of purity. They are small, gentle, of good form, with a tinge of dun on the face and legs. Their wool is of medium fineness, weighing 2 pounds per fleece. The wethers often produce mutton weighing 10 pounds per quarter.

36. *Welsh mountain-sheep.*—The Welsh is another mountain-breed, indigenous and still unmodified in the higher elevations, while they are the basis of the more cultivated flocks inhabiting the more productive valleys. They are small, weighing as store-sheep about 7 pounds per quarter. The head is small and well set up; the poll clean, except sometimes a tuft upon the forehead; the females generally hornless; the faces unusually white, with occasional instances of gray, speckled, or rusty brown. They are narrow-chested, low-shouldered, high-rumped, long-tailed, active in movement, having little regard for fences or hedges, hardy and thrifty with scanty herbage. The wool is fine, though not very even in quality; fleeces weighing about 2 pounds. They are not prolific, as one lamb is enough for a mother to care for in mountain-pastures, but are good nurses, and are sought for on that account for breeding fat lambs from Leicester or Down crosses.

In the winter, just before the lambing-season, the ewes are brought down from the mountain wilds and supplied with small quantities of hay or oats; if the latter, sheaf-oats are used, as the little Welsh sheep would not know what to do with clear grain. Lambs kept in the flock are shorn in July or August; and after weaning, the mothers are milked for a month or two, and butter is made, or the milk is used to improve skim-cheese.

They are too wild for ordinary farm economy of the lowlands, a new lot brought home disappearing in all directions if allowed the opportunity to scatter, and sometimes found on the roofs of neighboring cottages. Cheviots, or other breeds, do not thrive in their mountain-home, rendering it probable that they will not be superseded, though they may be modified.

37. *Cheviots.*—As the Black-faces monopolize the higher mountain-lands, the Cheviots occupy the lower elevations, the hills of the border counties between England and Scotland. They have been systematically improved by the use of carefully-selected rams of Lincolnshire, before the day of the improved Lincoln race. It has been claimed that the Leicester blood produced the improvement, but the hardiness of the breed, and the testimony of the breeders, tend to invalidate the opinion. They were formerly light in bone and wool, of scraggy frame, but with a constitution wonderfully hardy.

Draining of lands, provision of shelter, and a greater abundance, both of summer and winter food, have aided the efforts of the breeder, and the result has been one of the most useful and profitable of known

breeds of sheep. No animal has contributed so much to the prosperity of the Scottish border and hill farms as the Cheviot sheep. Their mutton ranks very high in Smithfield market, and some people give it a preference over the game-flavored mutton of the Black-face.

These sheep obtain their name from a range of hills running through the border countries of England and Scotland. The original improver of greatest repute is William Robson, of Bilford, who commenced his operations a century ago, and his flock became the nucleus of the ram-supply of all that region for many years. They are deemed useful for crossing with border Leicesters.

Ewes have their first lambs in April, at two years old, and are sold as culls at five or six, being replaced by ewe-lambs. They are sold for producing a crop of half-Leicester lambs. A practice has grown up among the hill-farms of sending the young wethers to winter on the grass-lands of the arable farms, of which they have the outrun from October to April. The cost of this wintering varies from 7 to 9 shillings per head. The main markets are Milrose and Lockeshire for lambs, and Falkirk for ewes and wethers, and Inverness in July, where sales are made "by character."

The fleece is taken off late, rarely before July, and is in constant demand for the manufacture of the goods known as tweeds. It is a middle wool, of better quality than formerly, differing somewhat with differing circumstances, being of superior quality when grown from dry, sweet herbage.

38. *Black-face.*—The breed of British sheep kept to the greatest age, and fed almost exclusively upon the natural growth of permanent pastures, and the management of which, therefore, bears the nearest analogy to our own practice in sheep-husbandry, is that generally known as the Scotch Black-face. It has the widest range of any of the British breeds. It is found, and has been for centuries—so long a period that doubts exist whether they are aboriginal or an importation during the Norman conquest or the Norwegian occupation of the Western Isles—upon nearly all the mountain-lands of Great Britain, including much of the area of Scotland, the mountain-chain extending through the north midland countries of England, and the heath and moor lands both in England and Scotland. They are a hardy race, whose place could not be occupied by any of the more improved breeds, enduring, to an almost incredible extent, both cold and hunger, and getting a fair subsistence beneath the drifts of winter, thriving where the pampered long-wools would starve. Nor are they like the Merinoes. Their wool is of inferior quality, hairy, uneven, used for carpets and coarse cloths, and weighs about 3 pounds per fleece. The average three-year old wether yields 28 pounds per quarter, deemed unequaled by epicurean taste in quality of meat and richness of gravy. The ewes are kept for five years, and are then drafted without distinction, while the wethers are full-grown and fat on good grass-lands at three; but they are now generally sold for fattening on turnips in the low countries.

Thus the slowest of breeds in maturing is made to subserve the purposes of meat-production, and increase the profits of sheep-husbandry conducted under apparently unfavorable auspices. As in Texas and Colorado in this country, no inclosures separate the flocks. Each has its owner's mark, which is invariably purchased by a succeeding tenant. These marks are known to the shepherds, and every strange sheep is returned promptly to its owner. They are usually branded on the horn, some flocks upon the nose, and others are known by ear-marks. On some farms a small quantity of coarse hay is saved in summer, and in seasons of storm, or great severity of weather, are fed from the stack. On some farms a low-lying field, with some shelter, is provided for the first week; but, as a rule, the "hoggs," as they are called, are sent to the arable or dairy farms of the lowlands, where they have the run of the stubbles and old pastures. From 5 to 6 shillings each are paid for their winter-pasturage of six months. They are especially valued for crossing with the Leicesters, their progeny at twelve months yielding, if well managed, 18 pounds per quarter, and a fleece of 7 or 8 pounds. A second cross is not so successful. An ewe that has dropped a Leicester lamb is called a "milled" ewe, and is held at a reduced valuation; if a second time, a "double-milled" ewe, with further deterioration. This results from the extra size of the lamb, tending to organic derangement in the ewe.

39. *Roscommons.*—Connaught has been for a long period the principal sheep-breeding section of Ireland, and the source of supplies furnished to the great Ballinasloe fair for the graziers of all other parts of the green isle. Culley described the original stock of Connaught as the most awkward and ungainly sheep to be found in the kingdom, with nothing to recommend them but their size. "These sheep are supported by very long, thick, crooked, gray legs; their heads long and ugly, with large, flagging ears, gray faces, and eyes sunk; necks long, and set on below the shoulders; breasts narrow and short, hollow before and behind the shoulders; flat-sided, with high, narrow, herring-backs, hind-quarters drooping, and tail set low; in short, they are almost in every respect contrary to what I apprehend a well-formed sheep should be; and it is to be lamented that more attention has not been paid to the breeding of useful stock in an island so fruitful in pasturage as Ireland."

The spirit of improvement reached this district; the smuggling of English animals, the importation of which was strictly prohibited, begat a desire for superior style and more satisfactory returns. At length the restriction was removed, and their improvement was vigorously conducted, the first means employed being a Leicester cross, by which the form was improved and the wool lost much of its coarseness. When it assumed the distinctive and fixed peculiarities of a new breed, it took the name of the Roscommon sheep. The breeders manifested much judgment in perfecting its points and skill in selecting the individuals by which it was accomplished. For the past generation the progress made has been remarkable, compelling the Royal Agricultural Society and the

Royal Dublin Society, which for a long time admitted them in a mixed class to their shows, to recognize them as a distinct breed of long-wools. The following statement of their present status is made by Mr. R. O. Pringle, editor of the Irish Farmer's Gazette:

"The old Connaught breed of sheep were never fattened until they were three or four years old, when they made great weights, but the mutton was coarse. In consequence of the improvement which has been made in the breed, shearling wedders are now often sold fat to the butcher, making from 25 pounds to over 30 pounds per quarter; but, as a general rule, the Roscommon graziers hold them over until they are thirty months old, at which age they are generally sold in Ballinasloe fair, at prices varying from three to four guineas each, to Leinster graziers, by whom the sheep are kept until they are about three years old, when they make from 36 pounds and upward per quarter. Draft ewes, fed after being cast for breeding, weigh from 34 pounds to 40 pounds per quarter, and the quality of the mutton is unexceptionable. It must be understood that the Roscommon sheep are, in general, reared entirely upon grass, with the help of some hay during winter. Turnip-feeding does not, as in Great Britain, form a material point in sheep-farming as conducted in Roscommon, there being only one acre of turnips grown in that country to each 109 acres of area. These sheep, from first to last, are for the most part reared and fattened without seeing a turnip. In all cases where turnip-feeding is pursued, the Roscommon sheep prove that early maturity, along with heavy weights, has become one of their characteristics; so that if turnip-growing were extended in the west of Ireland, it is only reasonable to believe that Connaught would produce much larger supplies of sheep than is done at present. With the pressure on the meat-market which now exists, this is, therefore, a point which deserves to be seriously considered."

The fleece is soft, deep grown, rich wool, the first weighing 8 to 10 pounds. Some old ewes have borne fleeces of 14 to 16 pounds; and the fleece of the prize-ram, "Prince Arthur," 24 pounds.

40. FRANCE.—Sheep-husbandry in France has had a constant if not a rapid growth in the past century. The numbers were ten and a half millions in 1789. Twenty-three years after Chaptal estimated the total at thirteen and a half millions, yielding 1,718,949 pounds of fine wool, 1,672,199 pounds of medium, and 70,208,926 pounds of coarse wool. In 1867 flocks had increased to thirty millions, but in 1872, after the war, they numbered less than twenty-five millions.*

* At the "Concours" at Sante Menehould, September 19, 1875, it was stated by M. Ponsard, president of the central committee of the department of Marne, upon the authority of M. Duchalean and M. Henzé, inspector-general of agriculture, that the number of sheep in France was reduced from 30,386,283 head in 1866 to 24,707,496 in 1872, a loss of 5,678,787 in six years. M. Duchalean had attributed this loss to the decline in prices of wool, but M. Ponsard, while admitting the operation of this cause, attributed a portion of the loss to the absurd law which allows the municipal councils to prescribe the number of head per hectare which each farmer is permitted to keep, a prerogative which had been grossly abused.

From such an exhibit it is plain that the Merino race had sixty years ago made little impression upon the flocks of the country, which were indigenous, bearing a fleece of coarse wool. At present the Merino and its grades comprise about two-thirds of the sheep of France.

The largest flocks are found in the mountainous areas of the southwest and of the center, and the distribution and numbers throughout the regional districts into which the country is divided is presented as follows, with the population of each, according to statistics presented at Vienna in 1873:

	Population.	Number of sheep.
Region of the north	2,729,866	3,560,416
Region of the northeast	2,966,404	1,325,222
Region of the southeast	3,832,780	1,793,128
Region of the south	3,478,974	3,320,304
Region of the southwest	5,162,245	5,144,554
Region of the west	4,869,743	1,670,858
Region of the center mountains	3,095,193	5,148,043
Region of the center plains	2,729,866	3,106,443
Region of the northwest	6,278,114	4,344,815
	35,143,185	29,413,783

These figures are official, from the census taken prior to the war, and prior to the reduction indicated in a former paragraph. The population is returned at 36,102,921.

The regions in which there was more than one sheep for every unit of population, according to the above table, were the north, mountains of the center, and plains of the center. The southwest nearly equaled in numbers the aggregate of population.

41. The Merinoes are quite generally distributed, but are most numerous in the hilly districts of the east from Belgium to the Mediterranean. In the region of the southeast they nearly usurp the pasture-range, a large proportion being grades founded upon native races, but grown mainly for wool. In the plains of Crau, in the western part of the department of Bouches du Rhone, a level, dry, and rocky region, this breed abounds. Here are found the Transhumantes or traveling sheep, which feed upon the winter-herbage of dry plains and spend the summer-months upon the elevated slopes of neighboring mountains, after the manner of sheep-husbandry in Spain—a practice in this country only known in the Rocky Mountains, and especially in the Sierra Nevada range in California. The metis-Merinoes, valued for meat-production as well as wool, are mostly in the northern areas of France, quite numerous north and east of Paris. The Dishley (or Leicester) cross is also abundant in the Plaines du Nord. Merinoes are spread through Des Plaines du Centre, and here are found Solognots, Berrichons, and Bourbonnaises, either pure or crossed with Southdowns or Charmoises. The *Barbarine* breed, of African origin, is found in the hot plains of the

south. The region of the southwest has among its native races the sheep known as Larzac, Roussillon, Lauragnaise, Landaise, and Beaurnaise. In portions of this district the Southdown is popular. The merino wools of France, particularly those of Beauce, Chatillon, and Santerne, like those of Spain, have a remarkably strong fiber. Brie and Chatillon combine in a high degree strength and softness.

A fleece remarkable for its brilliancy, fineness, and softness, a combing-wool peculiar and valuable, is supplied by the Mauchamp, a cross-breed deriving its fineness from the Merino, distinguished as much for its ugliness of form as for its richness of fleece. An accidental result of breeding was seized upon by M. Graux, and, by will and perseverance, developed into a well-characterized and permanent breed. Its form, originally far from perfect, has attained a good degree of symmetry.

The flock of Naz, created by M. Girod, of Ain, and M. Perrault, of Jotemps, is deemed perfect as wool-producers, yielding a fiber finer than that of the best Electoral.

42. The economic and agricultural conditions of France are evidently becoming more favorable to the raising of mutton-sheep. The extension of forage-plant culture, the establishment of rural industries furnishing refuse matter for feeding animals, the use of horses in agricultural labor from the improvement of neighborhood roads, and the ability of the masses to consume meats at higher prices, are circumstances which tend to the dissemination of the English breeds. The influence of the Paris Exposition was important in calling more general attention to the models in mutton-making. As might naturally be expected, it has been found that the Anglicizing of French stock is greatly preferred to the attempted naturalization and extensive breeding of English flocks. In Anglo-French cross-breeds are found satisfactory meat-production as well as desirable fleeces, and they are better suited to the soil, climate, economic conditions, and local demands of the country they inhabit. Southdown crosses upon the native breeds, in the central departments, bear a strong resemblance to English breeds, and differ very essentially from the Southdown and Merino cross in the department of Seine-Inferieure, which approximate the heavy, soft fleeces of the Dishley Merinoes, though still presenting something of the brown tinge of the paternal race. The Dishley (or Leicester) cross with the Merino is more general and popular. It exhibits distinct traces of English blood in small and horuless head, amplitude of barrel, and lightness of bone; and resembles the French ewes in a body better wooled with a softer and thicker fleece. The preferences of different breeders is shown in the greater prominence given respectively to the English and French types; in one case illustrated by great size and fine conformation, and in the other by a fine and soft fleece, covering well the head and limbs. And these preferences are not mere whims or accidental opinions, but are

FIG. 9.—Rambouillet Ram, 1787.
(Flock of Imperial Bergerie at Rambouillet.)

usually exercised in subordination to sound reason and the dictates of controlling circumstances.

43. As elsewhere throughout the world, the more productive plains and valleys furnish specimens approximating to the mutton-breeds; the more elevated plateaus, the less highly cultivated and valuable lands, are represented by animals valuable more especially for their wool, approaching manifestly the merino type.

It must be acknowledged that the Merino has assumed the first place in the sheep-husbandry of France. It has in less than a century nearly exterminated the native breeds in large districts, by the constantly progressing modification of form and fleece of the ancient sheep of the country.

Perhaps there has been more diversity of views among improvers than in the United States, where the fashion of a few eminent breeders becomes the *furor* of all engaged in wool-growing, as when the style of excessive grease and unbounded skin-corrugations, "wrinkles" that put money in the purse without rendering an equivalent, commands the following of the craft throughout the country. There has been evidently more originality and independence in the efforts of masters of the principal breeding-flocks of France.

44. The government establishment at Rambouillet exercised a marked influence in its departure from the established ideas of fine-wool breeding. At the first it aimed greatly to increase the size and symmetry of the frame and the weight of the fleece; afterward the example of England was emulated to a degree never attempted by breeders of Merinoes in any country, in striving to increase the feeding capacity and fattening capabilities, and to render the offal less in proportion to weight of meat. In doing this the original fineness of the wool, which has been the peculiar characteristic of this breed, was sacrificed, but not the value of the fleece, which became very heavy with a combing-fiber of great length and high utility. The accompanying illustrations (Figs. 9 and 10), of an original Rambouillet of 1787 and of the improved sheep of to-day, engraved from drawings prepared under the direction of the French minister of agriculture and commerce, show more plainly than any amount of verbal description the wonderful change which has been effected.

The national bergerie of Rambouillet was established in 1786 at the farm of that name in the department of Seine-et-Oise, the property of Louis XVI, who obtained from the King of Spain permission to import Merino sheep, and placed 364 selected animals of that breed upon the estate and ordered the erection of suitable buildings for an imperial breeding-establishment. The manager, Count Angivillers, neglected at first to provide shelter for the flock, but found it necessary subsequently to add sheep-sheds to the building-accommodation of the place. Another importation was again made in 1800.

The descendants of these animals have acquired qualities widely dif-

fering from the characteristics of their ancesters of even twenty-five years ago. Under the vigilance and care of Tessier and Bourgeois, not only has the breed been kept pure, but it has received a grand and peculiar development, which has given it a world-wide reputation and caused a demand from Merino breeders of America and Australia, as well as of the central nations of Europe. The total value of sheep sold from this establishment from 1797 to 1872 was 3,472,343 francs, averaging 45,688 francs per annum. The number and prices are as follows:

Average prices.

	1797 to 1834.	1835 to 1853.	1854 to 1872.
4,309 rams	462.16 f.	392.54 f.	859.84 f.
3,581 ewes	133.83 f.	62.39 f.	398.86 f.
3,025 mutton-sheep	27.73 f.	24.73 f.	37.54 f.
131,165 kilograms wool	4.39 f.	2.90 f.	2.38 f.

The establishment also has, at a distance of two kilometers from the farm, a flock of Mauchamp Merinoes, a race with a silky wool which M. Graux in 1828 found in a flock of Merinoes. This sub-race has many points of relation to the breed imported in 1786.

The bergerie of Rambouillet is under the direction of M. Bernardin, former pupil of the Agronomic Institute of Versailles.

45. Other breeding-establishments have built upon different models, though the principal flocks can be classed in two categories, one including those in which the wool is the ruling object, the other those in which the meat has perhaps equal prominence. A very small head, cylindrical trunk and light skeleton, and increased proportion of flesh characterize certain flocks; but larger numbers still seek rams of corrugated skin and heavily-wooled extremities. In this class there are few that aim to produce a fiber of extra fineness, and perhaps still fewer that do not obtain fleeces of increased size grown upon animals of greater weight. In this respect France is only yielding to the tendencies of the age in woolen fabrication, and complying with the conditions of successful agriculture in a populous country of comparatively high-priced lands. Still there are evidences that France is yet able to produce wools of the first grade of fineness.

The national bergerie of Haut-Tingry (Pas-de-Calais) was created in 1843, at Montcarvel, in the same department, and removed to its present location in 1859. Its object is to breed Dishleys and the cross-breed known as Dishley-Merinoes; many fine flocks of the latter are found in the northwest and upon the plains of the north.

The establishment at Haut-Tingry embraces 190 hectares (469.5 acres) of arable land and natural prairies. At the close of 1872 it had 179 Dishley rams and 249 Dishley-Merino rams. The animals and fleeces are annually sold at public auction. The following are the average

FIG. 10.—Rambouillet Ram, 1873.
(Flock of National Bergerie at Rambouillet.)

prices (from 1843 to 1869) at which sheep and wool were sold, first at at Montcarvel and then at Haut-Tingry:

	Montcarvel.	Haut-Tingry.
Rams	274.30 f.	341.16 f.
Ewes	175.00 f.	56.00 f.
Breeding-animals, (animaux de reforme)	29.98 f.	34.50 f.
Wool, per kilogram	2.68 f.	2.10 f.

The higher prices of rams indicate the importance of the crosses that have been effected between the Dishley and the Merino breeds. The establishment at Haut-Tingry, since 1858, has embraced a school of shepherds. The Haut-Tingry establishment is under the direction of M. Guédon, former pupil of Grignon.

The cross-breeds, formed by the use of Merino rams in the native flocks of Brie, Burgundy, Champagne, Provence, Roussillon, and other districts, are among the most profitable sheep of France. They are called metis-Merinoes, or simply metis. The best bear fleeces scarcely less valuable than full-bred Merinoes, and in form and figure equal the Dishley-Merinoes. They appear to be improving, acquiring a fixity of type that promises the establishment of a permanent breed. This permanence is already attested by the fact that such flocks, dating back to the beginning of the century, are now improving rather than degenerating. A few years have sufficed to create an enhancement of national wealth which would have required centuries to produce by selection and regimen alone.

46. The degree of aptitude for fattening attained by metis-Merinoes, the Dishley cross-breed, and even fine-wool sheep of full blood, as seen in all recent French exhibitions, is very remarkable. It is claimed that they have equaled the English Southdown and Leicester in fatness, and in earliness of maturing, some of these animals at eighteen months showing thirty teeth, while others of three years had only five.

At a recent exhibition at Paris the heaviest Merinoes weighed 84 kilograms, some of the best Southdowns averaged 69 at ten and one-half months; several Dishleys 60, at twelve and one-half; those of the Cotswold-Berrichon cross at the same age, 68; Southdown-Berrichons 44, at eleven months; and Dishley-Merinoes 80, at eighteen months. Merinoes weighing 185 pounds will be deemed heavy representatives of the largest of that family.

47. The ancient and unimproved-sheep of France are of less economic importance. They are found under various local names, as Berrichons, Bretons, Barbarines, (from Barbary,) Limosins, Poitevins, Solognots, &c., in regions not highly improved or productive of abundant forage-crops. Where improvement of lands begins, and higher culture is coming in vogue, these ancient sheep give immediate sign of going into retiracy,

as surely as the red man of America recedes before the advance of the white race. The increase of feeding-material renders necessary the introduction of a breed for which a profit can be derived in feeding; and the receipt of a substantial return for forage consumed begets a desire for the extension of the flock; and so these conditions act and re-act upon each other, as is so often observed in this country, in Great Britain, and elsewhere, producing modifications of farm-animals as well as of farm economy generally.

48. When a higher culture has been adopted, and the ability to produce better mutton achieved, the cultivator finds it a slow process to change the character of his flock by the influence of regimen and selection of animals for coupling, and prefers to adopt the surer and more rapid means of amelioration afforded by cross-breeding, which produces positive and immediate results. This accounts for the wholesale production of cross-breeds in certain districts in France. It is the attainment of fortune by intermarriage and resulting inheritance rather than by a life-time accumulation of small savings—a plan that works more satisfactorily with the ovine race than with the human.

The benefit of crossing is here still more positively recognized in the improvement of wool, which is thought to yield more slowly to the influence of regimen than size and weight, and tendency to fatten.

While the value of these results is so evident, it has been a matter for surprise that the unimproved sheep are so numerous. One reason is seen in the fact of the immense number of small proprietors, who deprecate change, and still consume their fleeces in domestic manufactures, using the same rude machinery, and giving the same negligent care to their animals, without reflecting that improved animals give a larger fleece in proportion to weight, and wool of better quality, and that such substitution would give their needed home supplies and a surplus for sale, without increasing the number of their flocks.

49. Upon a review of French sheep-husbandry, the candid observer must admit that intelligent flock-masters have in the main been wise in their refusal to sacrifice wool to meat, and attempt to vie with England in a course of breeding which is compulsory in that climate, choosing instead to produce a class of wool for which the peculiar character of their manufactures makes a strong demand. The extending use of combing-wools, not the coarse fiber of great length produced by the mutton-breeds, but that having much of the fineness of merino wool, with a material increase in length, has greatly stimulated the steady progress observed in this direction, and the increase of forage supplies has had its share in such modification of the Merino. Breeders have demonstrated, perhaps more successfully than in any other nation, that improvement in intrinsic value of fleece and in meat-production may keep pace with each other. The climate, soil, and agronomic conditions of this country have permitted this result.

50. *Austria-Hungary.*—At the time of the dispersion of Spanish sheep

through the principal sheep-walks of Europe, Austria was prompt to share the boon of fine wool. In 1775 the Empress Maria Theresa imported into Hungary 300 Merinoes, and located them at the imperial farm of Meropail. A school of shepherds was established, other importations were made, and the numbers of the new race increased and the modification, in some sections extinction, of the native races resulted.

The number of sheep of all kinds in Austria proper is between five and six millions; in Hungary, fifteen millions. In Hungary proper the number exceeds that of the population, a large proportion is of Merino blood, and the wool is remarkable for great softness and firmness, and cotton-like touch and aspect, not equal in strength to the German, and suited only to the light tissues. The great plains, so like our own western prairies, rich with abundant and enduring elements of fertility, furnish the best sheep-walks of Europe, in which the business of fine wools can be profitably carried on as long as it can exist in any portion of the continent. The wool of Galicia and of the archduchy of Austria is very similar, though not of equal fineness, the inferior grades having more hairy fiber. Moravia furnishes an excellent cloth-wool, coarser than the Hungarian. Those of Austrian Silesia approach the wools of Prussian Silesia in strength of fiber, with an approximation to the tenuity of the Hungarian. That of Bohemia is strong and hard, not very symmetrical, and especially adapted to combing purposes. A large proportion of Austrian superfine wools are used for cloth; fine wools are employed in both processes; medium mainly for combing, and some of the common wools of greater length are substituted for English long combing-wools and used in certain manufactures, and another class of it goes into low-priced cloth. M. Louis Moll, of France, makes the following classification of the wools of the Austrian Empire, produced in 1866, which will substantially indicate the quantity and styles at present grown:

	Superfine.	Fine.	Medium and ordinary.	Common.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Hungary	1, 234, 800	6, 174, 000	24, 696, 000	1, 234, 800	33, 339, 600
Bohemia	242, 550	1, 852, 200	1, 852, 200	.....	3, 946, 950
Moravia	121, 275	749, 700	749, 700	.....	1, 620, 675
Silesia	187, 425	496, 125	496, 125	.....	1, 179, 675
Galicia	.....	749, 700	1, 234, 800	1, 852, 200	3, 836, 700
Other provinces	.....	242, 550	1, 234, 800	.....	1, 477, 350
Total	1, 786, 050	10, 264, 275	30, 263, 625	3, 087, 000	45, 400, 950

51. According to the Hungarian census of 1870, Hungary had 15,077,000 sheep, an increase in thirteen years of 33 per cent., while horses increased only 3 per cent., cattle declined 6 per cent., and swine in a less degree. In Middle and Lower Hungary there are districts having as many as 5,000 to 6,000 sheep per square mile. In Hungary proper the number per square mile was 3,197, and 1,072 for every 1,000 inhabitants. In Siebenbergen the number was 1,928 to each square mile; in

Croatia and Slavonia 1,016; and in the Military Boundary 1,673. This region is the great sheep-walk of Europe. The export of wool in 1870 was 277,784 tons, worth 25,545,502 gulden, or more than $12,000,000 in gold.

The flocks of Hungary are mainly Merinoes, a few native sheep still remaining, and several flocks of native sheep cross-bred with Southdowns. The lands are becoming more valuable, arable culture is encroaching on the meadows, and supplies of forage are made necessary. Lucerne is found valuable both for summer and winter feeding. Red clover and sanfoin do not thrive on the dry plains. The French process of making "sour-hay" by fermentation is practiced considerably, both with maize and grass, the trenches being 4 feet by 6 or 8, and the forage compactly laid and covered with a foot of earth. It is common to keep the best flocks under cover at night and at midday in summer, and day and night in winter. They are not folded upon turnips as in England.

The lambing occurs at two seasons, April and May, and August and September, the ewes being carefully sheltered. The ewes are good nurses, of only moderate quality as milkers. The shearing is done in May, by women, in shearing-houses. In washing they are dipped a few times, then made to sweat to soften the dirt, after which they are washed and made to swim in clean water; in warm washing, with soap, a similar course is pursued, ending with cold water. Spring-lambs are washed in August. Breeding-ewes are sometimes fed with mangel-wurzel pulped with hay and straw. Store-sheep are rarely ever so fed. Culls are generally sold at low prices; in some cases they are fed and sold fat to butchers. Corn and oil cake are fed occasionally to rams.

The Hungarian Merino is horned in both sexes, the head well covered with wool. It is smaller than the French and Prussian, especially the Rambouillets, of which type few are found in Hungary.

52. GERMANY.—The introduction of Spanish sheep into Germany, commenced before the close of the last century, and actively continued during the first years of the present, has given great prominence to wool-growing industry, and has been the prime instrumentality in establishing the present high reputation of German woolens. Soon German wools began a sharp competition in the English market with the fine wools of Spain, and in a few years more almost drove Spanish fleece from English manufactories. The course of this contest affords a striking illustration of the rapidity and extent of the improvement in the hands of the industrious and patient German flock-masters. The imports of Great Britain derived from these countries were as follows, for the dates named:

	1800.	1814.	1827.
Germany	421, 850	3, 595, 146	22, 007, 198
Spain and Portugal	7, 799, 758	9, 234, 991	4, 349, 643

53. At the beginning of the improvement, and for a generation afterward, extreme fineness of wool was the constant and principal aim in breeding. It was carried so to excess that the constitutional vigor of the finest flocks was much impaired, and the light weight of fleeces was scarcely compensated by the highest prices paid for wool. Increasing commercial facilities and activities, the growing competition of South American and the British colonies, increase of population demanding enlarged meat-supplies, conspired to reduce the price of fine wool, and to bring about a revolution in sheep-breeding. In populous regions, areas of high culture, wool became subsidiary to mutton, a change effected by crossing Merino or native sheep with the Southdown or with the other Down families or with the Leicester. In districts of sparse population and low culture, and consequent low prices of mutton, the wool interest has retained its prominence, and by producing a fine grade of medium wool in heavy fleeces, with some attention to the flesh-making quality of the flock, the business has been quite remunerative.

The Merino race and its grades now constitute about half of the flocks of the German Empire. As divided by reliable local authority, there are 14,000,000 Merinoes, 7,000,000 English breeds and their crosses, and 8,000,000 native sheep, making in all 29,000,000. The annual wool-production is estimated at 125,000,000 pounds.

54. The mutton-interest is seen to have attained large proportions, and the tendency is still toward meat-production and large fleeces of medium fineness. It has required many years and bitter experience to produce this change. A comparison of prices at Berlin and Breslau, for forty-one years, illustrates the approximation in prices of fine and coarse wool that has taken place throughout the world, and renders plain the reason for enforcement of the policy that now rules in sheep-breeding:

	1830.	1840.	1850.	1860.	1870.	1871.
EXTRA FINE WOOL.						
Berlin	110	115	110	103	.....	69
Breslau	150	125	140	118	106	106
FINE WOOL.						
Berlin	76	78	85	91	63	59
Breslau	97	85	110	106	86	90
MEDIUM WOOL.						
Berlin	62	53	62	79	53	56
Breslau	77	65	80	94	67	71
COARSE WOOL.						
Berlin	46	38	42	60	45	49
Breslau	42	52	65	71	54	57

This is similar to the course of the market in Pesth, Hungary, from 1843 to 1872, during which period extra fine wool increased in price 14.8 per cent., fine 25.7, medium 46, and ordinary 60 per cent.

55. Saxony was the scene of the earlier triumphs of breeding in the

production of wool of a fineness not surpassed in the world. The Elector of Saxony, at the close of the seven years' war, in 1765, is said to have obtained from the King of Spain 100 Merino rams and 200 ewes, from the best Spanish flocks. He kept a portion on his own farms, near Dresden, and distributed the remainder through his dominion. Fine flocks are yet found there, though the force of circumstances has compelled a modification of fleece and form. The Electoral type predominates in Saxony, though for twenty-five years there has been a gradual departure from the extreme fineness by which the fame of Saxony wool was originally gained.

In few countries, if in any, has the business of sheep-breeding been so systematic as in Saxony. The best flocks have been under the management of educated agriculturists, either proprietors or employed flock-masters. Rams are selected with great care, and if the proprietor distrusts his own judgment, he employs an expert to make the selection. The most complete order is enjoined in all respects; stables are ample and cleanly; their temperature regulated by thermometers; fodder abundant and well kept. The lambs come in summer rather than in winter, and to this fact is attributed much of the reputation of Silesian sheep for hardiness and healthfulness.

56. Prussian Silesia has been almost equally distinguished for successful wool-growing. Following in the footsteps of Saxony, obtaining fine stock from that neighbor country rather than by original importations from Spain, the same preference for fineness of fiber naturally ruled the selection of breeding-stock, and the result was an early and wide-spread celebrity for wool of great fineness and value, and a profitable demand for thorough-bred rams for improvement of the flocks of European and more distant countries, including Australia and America. Though never so famous for "high-fine" fleeces as Saxony, Silesia has won the distinction of a more active and extensive demand for breeding-rams, by reason of their heavier fleeces and greater vitality. The departure from the Electoral type, characterized by its short and fine fiber, small size, and delicacy of organization, dates from the time when England began to forsake Germany for her own colonies in her search for wools. At this discovery a panic ensued, flocks were diminished, the short-sighted left the business, and the shrewd and far-seeing proceeded to inaugurate a radical change in the course of breeding by which sheep of larger size and greater vigor, yielding heavier fleeces of longer and coarser fiber, were substituted for the modified Electorals which had been bred from Saxon originals. Circumstances were favorable; the climate was moderate, the grasses nutritious, the surface dry and undulating, and flocks were therefore in full health and vigor, favorable to continued improvement, which progressed in the direction of comparative softness and elasticity of fiber, while size, constitution, and weight of fleece were maintained in a high degree. A wise care was exercised toward the improvement of pastures, the selection of food-plants most derivable for

sheep, and ample provision for equal and constant food-supplies throughout the year, as experience taught the necessity of such care to uniformity and abundance of the fiber.

The Silesian flocks of the present time, of Merino blood, are tending still further from the Electoral type, once so popular, toward a more compact frame and heavier fleece. It is beginning to be acknowledged, in the very strongholds of fine wools, that no country of dense population and high prices of lands can afford to limit its aim in sheep-breeding to the production of wool alone.

57. Bavaria, which has not been regarded as a sheep-raising country of much note, is bestowing more attention upon this interest. Valuable flocks may now be found in the Suabian and Neuburg districts, and in the three Frankish provinces, Upper Pfalz, and in the Pfalz. The Merino race has been represented here for three-fourths of a century, yet a considerable proportion are Zaupels and other native breeds. Improvement has of late been rife, but cross-bred animals are sought rather than Merinoes, such as are well developed, thrifty, easy to fatten, producing acceptable mutton and a medium grade of wool. The Zaupels have a coarse, long wool, suitable for smooth stuffs of coarse texture, and available for flannels and yarns. They fatten easily, and their meat is of good quality. They are small, weighing only 40 to 50 pounds.

Styrian sheep, descendants of the Bergamask race, have been brought from the Styrian and Carinthian Mountains, in the course of trade with Upper and Lower Bavaria, and have spread to the Danube River, and through the valley of the Iser. They are heavier than the German sheep, with long heads, pendulous ears, and long legs. They are hardy, fatten readily, but their meat is coarse and bones large, and as wool-bearers they are inferior to the German sheep. The mountain-sheep of Upper Bavaria and Algau are related to the Styrian, but are smaller with coarser wool.

Some of the larger estates still adhere to Merino flocks of the Electoral type, of small size, weighing only 48 to 50 pounds, live weight.

In Neuburg are flocks of very fine cross-bred sheep, mature wethers weighing 95 to 110 pounds, and ewes 75 to 80 pounds, and yielding wool $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long, (*secunda* and *tertia* grades,) useful both as a cloth-wool and combing-wool. The coarse German cross-breds (Rauhbaster) are mostly found on smaller estates, especially near Bamberg and in the Main Valley. The ewes weigh 85 to 95 pounds, the wethers 110 to 120 pounds. The fleeces average 3 to $4\frac{1}{2}$ pounds, of *tertia* and *quarta* grades. The true German sheep, or "land-sheep," unimproved, are scattered through the Frankish provinces and Upper Pfalz.

Only one of the government Merino breeding-folds now remains on the public estate at Schleisheim, though individual sheep-raisers have established valuable flocks for breeding-purposes, both of Merinoes and Southdowns. The Schleisheim flock has been in existence since 1802.

Throughout Germany the tendency exists, modified variously by the

circumstances briefly touched upon in this chapter, toward the production of more and better mutton in connection with such supplies of wool as the required modification by breeding and feeding naturally produces.

58. Russia.—The immense areas of natural pasturage in Russia are capable of sustaining vast numbers of sheep, which have been increasing constantly, until the aggregate probably reaches 50,000,000, the number reported in 1870 being 48,132,000. The Merinoes comprise only about one-fifth of the whole number. The Electoral was established in some sections, especially in Polish provinces, but the Negretti gives better satisfaction and now predominates. The Russian Negretti is claimed to excel the Merino of any other name or country in hardiness. The immense flocks of the great plains become hardy by the "survival of the fittest" in the encounter of the elements and sharp competition for the means of subsistence.

There are flocks of immense size in Russia. One at Novo-Voroutsovka numbers 30,000 Merinoes, 600 Montaguardo sheep, besides 1,000 Angora goats. Another is reported of 50,000.

FIG. 11.—Cotswold Rams imported by Burdett Loomis, Conn.

CHAPTER III.

INCREASE OF PRODUCTION AND MANUFACTURE.

INCREASE OF WOOL-GROWING IN THE UNITED STATES; GREAT PROGRESS IN MANUFACTURE; THE WOOL-PRODUCT OF THE WORLD.

59. As has been briefly shown in the preceding chapter, the development of the factory-system of woolen industry throughout the world has been, in very large proportion, the result of the enterprise of the past hundred years. Prior to that time the woolen clothing of all countries was largely the product of home industry. At the present date home manufacture of woolens is a comparatively small industry in any portion of the world, especially in the more cultivated and progressive countries.

With the first settlers of the wilds of America came selections from the domestic animals of Europe, but the numbers were small up to the close of the seventeenth century, about which time the impulse to improve the grade and increase the quantity of wool, which so interested the bucolic mind of England, and Germany, and France, began to be felt in the United States, and importations of Spanish Merinoes were made by enthusiastic breeders. The farmers were generally slow to see the advantage of the improvement, yet flocks increased, a better quality of wool stimulated manufacture, and at the commencement of the war with Great Britain, which was inaugurated in part to cripple the growing manufactures of the colony, and thus demonstrate the peculiarly British idea of freedom of trade, (which means the freedom of home-trade and the destruction of colonial manufacture,) the wool-product was rapidly increasing and manufactures were extending and prospering, amounting in 1810 to the value of $25,608,788.

60. At the close of that war, with manufacturing prostrate and importations excessive, this industry had a bare existence; and in 1820 the value of its products was only $4,413,068. Its rate of increase since has been variable, as tariff legislation has fluctuated. In 1830 the total was $14,528,166; in 1840, $20,696,999; in 1850, $43,207,545, reaching $61,894,986 in 1860. But the great advance of this interest, its magnificent achievement in new styles and superior qualities of goods, has been since that date. In 1870 the total value of all products was

$155,405,358. The numbers of establishments, of cards, and of hands employed are given in detail for the several States:

States and Territories.	Establishments.			Hands employed.			No. of sets of cards.	
	1870.	1860.	1850.	1870.	1860.	1850.	1870.	1860.
Alabama	14	6	.....	41	198	.....	24	14
Arkansas	13	.....	.....	31	.....	.....	17	.....
California	5	1	.....	659	60	.....	46	6
Connecticut	108	84	149	7,297	3,767	5,483	660	265
Delaware	11	4	8	399	114	140	30	8
District of Columbia	.....	.....	1	.....	.....	2	.....	.....
Florida	1	.....	.....	1	.....	.....	1	.....
Georgia	46	11	3	563	383	78	72	30
Illinois	109	21	16	1,736	162	178	250	37
Indiana	175	79	33	2,469	533	246	346	112
Iowa	85	12	1	1,088	120	7	199	13
Kansas	9	.....	.....	91	.....	.....	24	.....
Kentucky	125	37	25	683	437	318	208	83
Louisiana	2	1	.....	29	60	.....	12	4
Maine	107	26	36	3,042	1,027	624	331	80
Maryland	31	27	38	327	381	362	60	44
Massachusetts	185	134	119	20,550	12,969	11,130	1,367	821
Michigan	54	16	15	667	126	129	116	14
Minnesota	10	.....	.....	146	.....	.....	19	.....
Mississippi	11	4	.....	116	235	.....	17	13
Missouri	156	11	1	718	70	25	258	15
New Hampshire	77	51	61	3,750	1,518	2,127	351	146
New Jersey	29	35	41	1,094	835	898	81	61
New Mexico	1	.....	.....	20	.....	.....	1	.....
New York	252	140	249	8,812	4,220	6,674	845	324
North Carolina	52	7	1	249	253	30	78	23
Ohio	223	115	130	2,243	728	1,201	334	173
Oregon	9	1	.....	179	30	.....	21	4
Pennsylvania	457	270	380	12,764	6,088	5,726	1,317	483
Rhode Island	65	57	45	6,363	4,229	1,758	474	253
South Carolina	15	1	.....	53	92	.....	25	10
Tennessee	148	1	4	428	10	17	177	1
Texas	20	2	1	100	43	8	29	4
Utah	15	.....	.....	106	.....	.....	19	.....
Vermont	65	46	72	1,870	2,073	1,393	175	99
Virginia	68	45	121	278	494	668	116	50
West Virginia	74	.....	.....	316	.....	.....	132	.....
Wisconsin	64	15	9	775	105	25	134	19
Total	2,891	1,260	1,559	80,053	41,360	39,252	8,336	3,209

To supply material for this rapid growth, the home production of wool has been insufficient. The census-returns of sheep and wool are as follows:

	Number of sheep.	Pounds of wool.
1850	21,723,220	52,516,959
1860	22,471,275	60,264,913
1870	28,477,951	100,102,387

These figures are not complete, as they only give an approximation of the number of sheep actually on farms at the date of the return, and the amount of wool is still less complete, as the returns of fleeces of sheep slaughtered in cities are not given. The real number of sheep in 1870 was not less than 34,000,000, and the quantity of wool estimated by the writer at that date was 135,000,000, which was not too high, and may have been 10,000,000 less than the actual product. The present number, not less than 36,000,000, are estimated to produce, with the additional fleeces of those slaughtered within the past year, 155,000,000 pounds.

In addition to the domestic product, the annual receipts of wool from foreign countries since 1860, with the value of woolens imported, are as follows:

Years.	Woolens.	Wool.		
	Value.	Pounds.	Value.	Cents per pound.
1861	$28, 261, 039	36, 000, 000	$4, 961, 326	13. 7
1862	14, 884, 394	43, 571, 026	6, 994, 606	16
1863	20, 411, 625	73, 897, 807	12, 553, 931	16. 9
1864	32, 139, 336	90, 396, 104	15, 923, 991	17. 6
1865	20, 347, 563	43, 858, 154	7, 728, 383	17. 6
1866	57, 115, 901	67, 917, 031	9, 381, 083	13. 8
1867	45, 813, 212	36, 318, 299	5, 915, 178	16
1868	32, 371, 329	24, 124, 803	3, 792, 659	15. 7
1869	34, 560, 324	39, 275, 926	5, 600, 958	14. 2
1870	34, 435, 623	49, 230, 199	6, 743, 350	13. 6
1871	43, 751, 973	68, 058, 028	9, 780, 443	14. 3
1872	52, 176, 260	122, 256, 499	26, 214, 195	21. 5
1873	50, 875, 805	85, 496, 049	20, 433, 938	23. 9
1874	46, 732, 032	42, 939, 541	8, 250, 306	19. 2
1875	44, 440, 940	54, 903, 654	11, 069, 701	20. 1

The average importation of wools was, therefore, about 57,000,000 pounds for the war period, 43,000,000 for the subsequent five years, and 74,000,000 for the last five years. The average cost for the period of ten years was $7,959,546 per annum; since, $15,149,716.

These supplies are obtained mainly from South America, England, Australia, and South Africa, in proportions as follows:

Years.	Great Britain.	South Africa.	Australia.	Argentine Republic.	Uruguay.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1862	16, 006, 963	3, 920, 257	783, 670	5, 786, 868	14, 061
1863	17, 619, 123	6, 711, 975	118, 234	17, 461, 208	476, 815
1864	13, 099, 501	13, 717, 900	864, 548	23, 951, 506	3, 490, 800
1865	1, 980, 176	8, 312, 768	408, 592	16, 103, 889	1, 164, 260
1866	8, 541, 195	7, 424, 217	874, 119	36, 916, 794	2, 224, 629
1867	6, 758, 820	2, 033, 020	467, 025	12, 666, 274	1, 434, 594
1868	2, 581, 678	964, 314	.....	5, 835, 864	466, 712
1869	8, 598, 299	2, 644, 504	.....	8, 249, 659	932, 369
1870	8, 140, 697	5, 089, 153	168, 902	16, 721, 420	1, 547, 106
1871	15, 593, 166	6, 699, 057	19, 957	23, 333, 237	4, 594, 238
1872	40, 250, 449	14, 820, 876	12, 748, 548	24, 731, 834	7, 110, 871
1873	19, 040, 920	12, 830, 858	7, 661, 262	17, 449, 563	6, 110, 911
1874	7, 966, 382	4, 622, 273	3, 905, 671	8, 502, 627	4, 094, 275

The increase of the average price in recent years, as seen in a former table, is explained by the large proportion, as shown above, obtained from Great Britain and her colonies, producing wool of better quality and higher price than that of South America.

The average supply since 1870 may properly be placed at 224,000,000 pounds, of which two-thirds is home-grown; but the nominal third of the foreign is mostly unwashed merino and low-grade carpet-wool, constituting not more than one-fourth of the value of our wool-supply.

Nor is this the whole extent of our woolen manufacture. There is a large amount of shoddy, mungo, and other material, as well as cotton and other vegetable fiber, that is used to adulterate and extend the

production of woolens. Of these, the recent imports of shoddy are as follows:

Years.	Pounds.	Value.	Price per pound.
			Cents.
1862	6,291,077	$442,376	7
1863	7,867,601	581,234	7.3
1864	8,133,391	621,514	7.6
1865	4,863,064	410,395	8.4
1866	7,147,108	589,490	8.2
1867	5,220,296	518,479	9.9
1868	556,414	49,649	8.9
1869	832,283	68,103	8.1
1870	512,792	55,009	10.7
Total	41,424,026	3,336,249	
Average	4,602,669	370,694	8
Average for the past five years	1,831,456	163,964	8.9

61. The record of our importations of woolen goods should also be presented. Going back to 1820, and dividing the values of imports by decades, we have the following result for fifty-five years:

	Aggregate.	Annual average.
Ten years ending 1830	$86,182,110	$8,618,211
Ten years ending 1840	129,336,258	12,933,625
Ten years ending 1850	109,023,552	10,902,355
Ten years ending 1860	282,682,830	28,268,283
Ten years ending 1870	320,340,346	32,034,034
Five years ending 1875	237,976,988	23,797,698
Total in fifty-five years	1,165,542,084	21,191,674

It is a suggestive and gratifying fact, that while the value of our manufactures is about four times as great as in 1850, the average of imports of woolens of the past five years ($23,797,698) exceeds but little that of the entire period of fifty-five years, ($21,191,674,) beginning with the very infancy of this beneficent industry. It is particularly noteworthy that our imports since 1870 are less by several millions annually than for the period between 1850 and 1860, notwithstanding the immense increase in the consumption of woolen goods.

62. The necessities of the Government for revenue, and the happy agreement of producers of wool and makers of cloth, have conspired to give a stability to customs-legislation for a period comparatively long, and a profit to both manufacturers and wool-growers, and at the same time lower prices to consumers of woolen goods than could be possible in the cloth-famine resulting from consumption without production in the United States. If now the interests of mere carriers, who desire larger profits for *handling* goods than manufacturers expect for *making* them, are not again made paramount, the future of the woolen manufacture will soon be secure; new triumphs of invention will be gained, every variety of fabric will be produced in this country, and all classes will thrive equally, except that importers of woolens will fail to realize their thousands with greater ease than the wool-grower now obtains his hard-earned dollars.

It is not proposed to enter into details of wool-growing in this country,

to describe its breeds, report the progress of improvement, or indicate the probable direction of future efforts of sheep-breeders. It is sufficient here to say that the American Merino is still the sheep of the country, with a distinctive character of its own, and a higher value for our uses than its most noted congeners abroad; that sheep-husbandry is increasing, not east of the Missouri, but manifestly in the continental area of nutritious pasturage beyond, and that the production of early lambs and fat mutton, with the increase of the numbers of easily-fattening breeds, is making slow but sure progress in the more populous and highly-cultivated districts.

63. WOOL-PRODUCT OF THE WORLD.—In conclusion, I will attempt to give, from examination of official records of wool-production, and from comparison of estimates of experts where no official data are found, or where such records are several years in arrears, an approximate idea of the amount of wool produced in the world, and also the numbers of sheep of all kinds that are domesticated and kept for the production of wool. In this investigation the incompleteness and tardiness of official enumerations, and the evident lack of public appreciation of the value of statistics, is painfully apparent; and yet the enumeration of domestic animals is among the simplest and most practicable of accomplishment of all census-work. In the more advanced and intelligent communities, these records are nearest complete. The official returns of sheep rarely if ever exceed the true numbers; it is often the case that they underestimate them. It is believed that in this country the census-aggregates approximate closely the real numbers, except in Texas, California, and in some border States, in which large flocks are kept in situations remote from the view of assessors. The census of Great Britain is probably quite accurate, and that of the central countries of Europe measurably so. The latest available official publications of the numbers of sheep in European countries, some of them eight to ten years in arrears of the present date, are given as follows:

Countries.	Date.	Sheep and lambs.
Great Britain	1874	30, 313, 914
Ireland	1874	4, 437, 613
Russia	1870	48, 132, 000
Sweden	1872	1, 659, 644
Norway	1865	1, 710, 000
Denmark	1871	1, 842, 481
Prussia	1873	19, 624, 758
Würtemberg	1873	577, 290
Bavaria	1873	1, 342, 190
Saxony	1867	304, 087
Holland	1872	855, 265
Belgium	1866	586, 097
France	1872	24, 589, 647
Portugal	1870	2, 706, 777
Spain	1865	22, 054, 967
Italy	1867	11, 040, 339
Austria, (proper)	1871	5, 026, 398
Hungary	1871	15, 076, 907
Switzerland	1866	447, 001
Greece	1867	2, 539, 538
		194, 867, 003

Next to the European flocks in numbers and in alliance of blood and proprietary interest are those of Australia, which here includes all British colonies in that antipodal region. The increase of sheep has been marvelous. The imports of Great Britain from that quarter were only 10,000,000 pounds of wool in 1840; they were 39,000,000 in 1850; 53,000,000 in 1859; 158,000,000 in 1869; and 238,000,000 in 1874. Since 1868 all these colonies except Queensland and Tasmania have increased their flocks, some of them very heavily, averaging in the table below about 17 per cent. notwithstanding the decrease in the two named. It is really more, probably at least 20 per cent., as the latest New Zealand figures are those of 1871, some of the others of 1873, and some of 1874. The returns are as follows, being the latest extant at the respective dates of publication, 1868 and 1874:

Colonies.	1868.	1874.
New South Wales	13,909,574	19,928,590
Victoria	9,532,811	11,323,080
South Australia	4,477,445	5,617,419
West Australia	599,756	748,536
Queensland	8,921,784	6,687,907
Tasmania	1,742,914	1,490,746
New Zealand	8,409,919	9,700,629
Total	47,594,203	55,496,907

In Asia the investigation rests necessarily upon more obscure data, and the more moderate estimates are excepted. The estimate 350,000,000 pounds covers the entire area of Asia, consisting mainly of the wool of Asiatic Russia, Turkey, Persia, and India, as large portions of China and Japan are said to be substantially non-producing. It is less by 30 per cent. than some current estimates, and believed to be more consistent with a conservative and judicious view of the probabilities.

There has been a recent increase in the production of the Cape of Good Hope, and the estimate is certainly not too high, in fact scarcely more than the actual shipments for the past two or three years. As to South America, it is difficult to find in any markets, or in home consumption, the quantity sometimes attributed to this quarter of the globe.

After careful analysis of recent and former statistics the following estimate is presented both of sheep and wool:

Countries.	Number of sheep.	Pounds of wool.
Europe:		
Great Britain	35, 000, 000	218, 000, 000
German Empire	29, 000, 000	125, 000, 000
Austria-Hungary	21, 000, 000	60, 000, 000
Russia	50, 000, 000	138, 000, 000
France	26, 000, 000	124, 000, 000
Spain	22, 000, 000	69, 000, 000
Portugal	2, 750, 000	11, 000, 000
Italy	11, 000, 000	38, 000, 000
Turkey	15, 000, 000	37, 500, 000
Greece	2, 600, 000	7, 500, 000
Switzerland	550, 000	2, 500, 000
Denmark	1, 900, 000	8, 000, 000
Holland	900, 000	4, 500, 000
Belgium	600, 000	3, 500, 000
Sweden	1, 700, 000	6, 000, 000
Norway	1, 750, 000	6, 250, 000
Total	221, 750, 000	858, 750, 000
America:		
United States	36, 000, 000	155, 000, 000
Canada	2, 000, 000	8, 000, 000
South America and Mexico	58, 000, 000	174, 000, 000
Total	96, 000, 000	337, 000, 000
Asia	175, 000, 000	350, 000, 000
Africa:		
Northern	20, 000, 000	45, 000, 000
Cape of Good Hope	12, 000, 000	51, 000, 000
Total	32, 000, 000	96, 000, 000
Australia	60, 000, 000	255, 000, 000
Grand total	584, 750, 000	1, 896, 750, 000

The estimate of Great Britain is based upon $4\frac{3}{4}$ pounds of wool per fleece, with 52,000,000 pounds for wool of sheep butchered during the year. The number thus disposed of is usually reckoned at three-eighths of the standing numbers of the flocks. In the German Empire the average is placed at $3\frac{3}{8}$ pounds, with 6,000,000 fleeces of 3 pounds from slaughtered sheep. Hungarian fleeces are lighter, and in Austria-Hungary the extra fleeces are assumed to bring the average nearly to 3 pounds for each sheep. France produces heavier sheep and fleeces than the German States, more mutton-sheep, with a larger proportion annually slaughtered, making 124,000,000 pounds for standing flocks of 26,000,000 sheep a reasonable estimate. The South American fleeces are variable, but the average is much lower than in South Africa or Australia, and the sheep of Asia cannot be safely estimated to yield more than 2 pounds each.

There are some sheep in the islands of the Pacific, rendering the total estimate of 1,900,000,000 pounds very probable, and the number of sheep of the world 600,000,000 in round numbers.

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